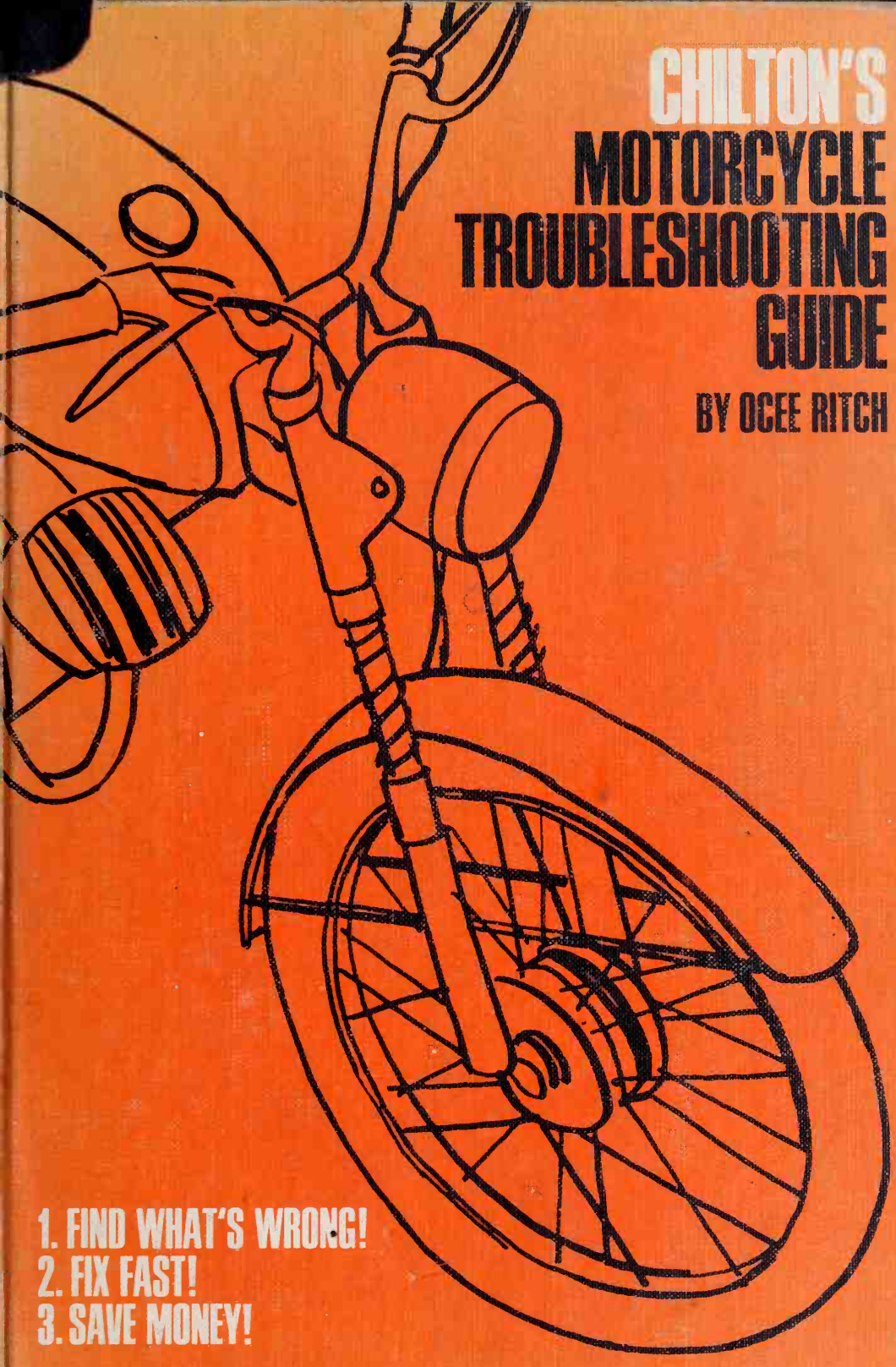
CHILTON'S MOTORCYCLE TROUBLESHOOTING GUIDE

BY OCEE RITCH



1. FIND WHAT'S WRONG!
2. FIX FAST!
3. SAVE MONEY!

Two-Stroke Engines • Four-Stroke Engines • Transmissions • Electrical Systems • Frame • Suspension

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Chapter 1

The Four-Stroke Engine

The commonest complaint or trouble encountered by the motorcyclist is that the machine will not start. The reason can be extremely simple or it can be more complicated, but the basic procedure for determining *what* the cause of non-starting is and *how* it can be corrected should be followed in order to save time and to cover all the possibilities. By following an outline, the trouble-shooter can also mentally or visually eliminate some steps and begin his trouble search at any point in the sequence knowing that he will not have to back-track.

Non-starting is extremely frustrating in view of the fact that it is generally accompanied by some severe physical exertion. Pumping a kick-start lever on a big-displacement bike adds to the rider's indignation and the most common reaction is to hurriedly guess at the cause of malfunction—which usually leads to disgust and abandonment of the project. The first rule is to go step-by-step and methodically eliminate possible causes.

Like any four-stroke-cycle engine the motorcycle's powerplant obeys certain laws. The first law is that there must be fuel and air in the proper proportion. The second is that there must be spark at the proper time. If these two are present, combustion must take place. The motor may not run long, smoothly, quietly or with good power, but it should at least run. Therefore the first step in starting a balky bike is to be absolutely sure you are following the *correct starting procedure.*

This may seem like worthless advice to the owner who has been riding a given cycle for some time, but if you are at all unfamiliar with a bike engine it is easy to apply the wrong technique and get results only part of the time.

STARTING PROCEDURES

Question: Is the fuel tap really "On"? If there is any doubt about fuel level, turn the tap to "Reserve." On many British bikes there are two taps, one for regular and one for reserve. With a double-ended push-tap, the hex end controls the reserve. If you aren't sure, before making any starting attempts, remove the line at the tap and observe fuel flow.

With a supply of fuel assured to carburetor, depress the float tickler (on Amal type carburetors) until gas appears and close the air slide or close the choke. On some older Triumphs, the S.U. (automobile type) carburetor has a lever at the bottom which is to be pulled up for starting and pushed back down when the engine warms up. In any event, richen the mixture for starting in the applicable way.

① Kick the engine over a couple of times with switch off and throttle open. (This should also be done in cold weather on cycles equipped with electric starter.) Hondas with electric starters can be turned over with the starter a few times with the switch in #1 position. ② Open throttle slightly —about ⅛ of the total travel and set spark control (if fitted) to about one-half of full advance. On British singles with compression release, push the starter lever down until the piston is felt coming to compression, then operate the compression release and follow through gently on the pedal to get the piston past compression. This is a couple of inches of pedal travel, generally. ③ Kick the engine over briskly, getting all of your weight onto the lever and straightening your leg at the same time. *Note:* Resist the temptation to open the throttle wide at the first cough of the engine.

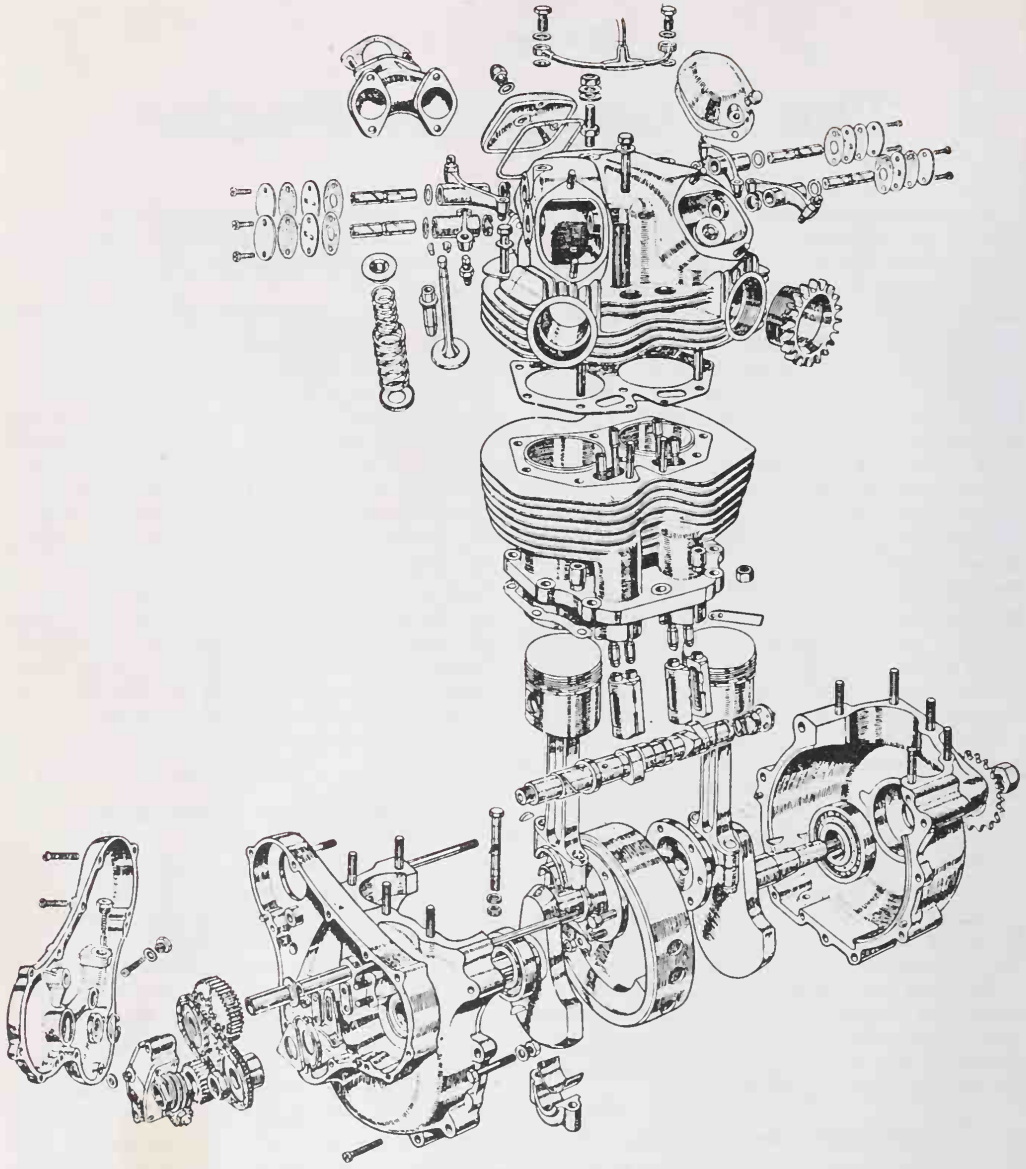
THE ENGINE WON'T START

Assuming that repeated applications of the foot to the pedal resulted in nothing but sweat on your brow, it is time to look for malfunctions. Check the choke and throttle controls first.

Is the key really on? Twiddle the key in the switch a bit. Be sure indicator lights are on or try the horn in an effort to determine if the necessary electrical current is present somewhere in the system.

If there is an obvious supply of electricity: re-check the fuel supply. Switch to reserve. Turn switch to emergency start position and try again. If there is a smell of raw gas, or visual evidence of flooding such as fuel on the carburetor, open the throttle wide and kick the starter or operate the electric starter to turn the engine over several times and thus clear out the excess fuel. If the bike doesn't start now, further checks are necessary in the fuel supply, for which see below.

If indicator lights or other accessories do not function: suspect bad connections, blown fuse or bad battery. For example: even though some Hondas have an AC magneto system a discharged battery in the circuit can make the bike hard to start and poor running. Check the fuses in any model; also check all electrical connections



Exploded view of the 1961-1963 Norton Twin.

for cleanliness and tightness, particularly the battery ground. This is highly critical. (The fuses will vary in location but will always be close to the battery.)

If fuses look good and connections seem in order, check the battery. The following advice will scandalize battery makers and it is admittedly not good practice, but you can satisfy yourself that there is juice (or not) by striking a quick arc across the battery terminals with a piece of wire or the handles of a pair of pliers. Do this very briefly, just enough to get a flash.

If the battery is strong and a good spark results, examine the terminals, removing, cleaning and replacing if in doubt as to their ability to pass electricity.

If the battery responds weakly or not at all to the direct-short technique, either have it charged, switch to emergency starting position (if available) or push the bike. If a dead battery is the sole problem, most cycles will push start fairly easily. Cold weather and a big bike may make the

process a bit difficult physically, but the generating system on all models is designed to put out power at low RPM, so this helpful feature which is not present in the automobile system works for you. *CAUTION: If you have the battery charged, read the section on ELECTRICAL SYSTEMS in this book before rushing down to the nearest service station.*

If after taking this precaution the engine still won't catch, it is time to check for a spark at the plug. (We will use the singular to save words. If your model has more than one cylinder, mentally substitute the word plugs.)

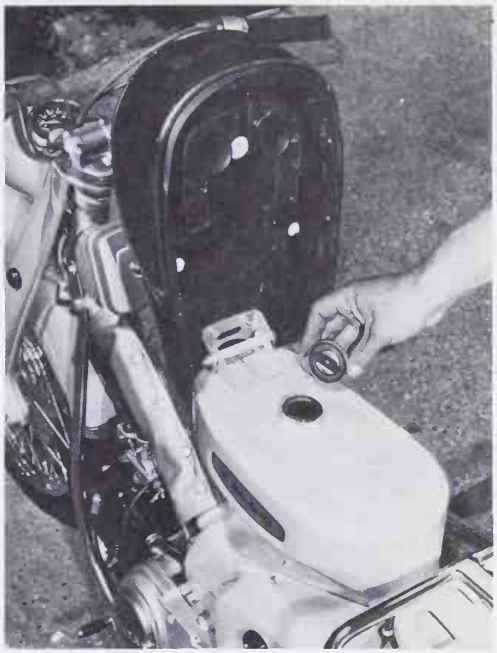
Remove the plug and examine the tip. If it is wet or clogged with carbon deposits, this can be the problem. Replace it with the spare you always carry in the tool kit. Second choice is to clean it. Or,

If plug appears to be good, leave it connected and place it on the head, making sure it is grounded; then kick the starter briskly. A fat, blue spark should leap between the electrodes. If the spark is a bit weak, check the gap against specifications, since it may be too wide.

Here is a trick which will often get the machine running until you can get a new plug: Close the gap right up to .010″ or so and re-install it. It may be breaking down under pressure in the cylinder and the smaller gap will permit it to function temporarily.

If you don't have a feeler gage, an ordinary paper matchbook cover is just under .010″ thick. Make the electrode gap a slip fit for a matchbook cover and it will be close enough to play jazz, as we used to say in the music business.

If there is no spark at the electrodes and you are sure the grounding of the plug is good and that the high tension lead (plug wire) is firmly connected at each end, you've got ignition troubles. Now, this may be a bad coil or other problems which are better covered in the ELECTRICAL SYSTEMS section of this book. Just to satisfy yourself whether the system is functioning or not, grasp the plug in one hand and push the starter lever down politely. (Don't jump on it or your eyes are liable to light up like a pinball game.) You'll feel a tingle if the ignition system is developing output. If you get no indication of electrical energy, you've isolated the problem.

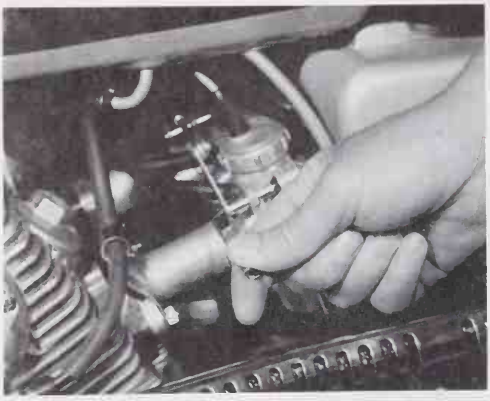


When bike won't start preliminary step is to make sure that fuel is present in tank.

If the spark plug is good and you get a blue spark, there is a bare possibility that the timing is so far off the bike won't start. But chances are the trouble is somewhere in the fuel system. Check the timing as a precaution, then turn the fuel tap off and remove the fuel line from the tank. Then, holding a rag or a container under the opening, turn the tap back on and observe fuel flow, if any. You can also observe whether you really have gas in the tank or some other liquid, such as water. Also, if the bike has been in storage for some time, the gas can have decomposed to such an extent that it won't burn. The highly volatile elements that make for quick starting in a fuel blend vaporize readily. This makes old gas equal bad gas. It generally has a strong, pungent odor as opposed to the keen, light smell of fresh fuel.

Water, of course, balls up in little droplets on

Be sure that fuel tap is in correct position.



Make sure that choke is operating properly.

Jiggle the ignition switch and rotate it a few times to be sure of making contact. Some models have emergency start position on switch.

the rag while gas soaks right through. Water also sinks to the bottom in a container. How does water get into fuel? Condensation can account for some. Who knows how the large quantities we sometimes find can be accounted for? Not me, but there they are.

If fuel flows for a moment, then stops, you have a plugged vent. Remove the filler cap and the flow should begin again. If so, unplug the tank vent, whether it is in the cap or in the tank.

On Honda 250 and 305 models, the cork gasket has been known to plug the vent hole. It is sometimes necessary to drill another vent hole in the cap liner.

If fuel flows freely, or if it is obviously dirty, rusty or full of sediment, there will be trouble farther along the line. So, remove the fuel line at the carburetor, take out the wire gauze strainer at the banjo, if so equipped, and clean it.

At this point, if there is fuel at the carburetor and the plug was good and not wet on examination, try heavy choking. Make sure the choke is really working. Then, if it doesn't start, get into the carburetor lightly.

First: close the fuel tap at the tank and replace the line.

On Amal type carburetors, unscrew the *bottom nut* using another wrench to hold the larger nut above and prevent its turning.

Note: The larger nut is the jet retaining nut and it is against a red fiber washer. If loosened, the washer must be replaced because it invariably leaks, so don't move it.

Observe the amount and character of the fuel which flows out (if any). If there is no fuel, the needle valve is stuck closed. Tap on the carburetor float bowl and it will free up.

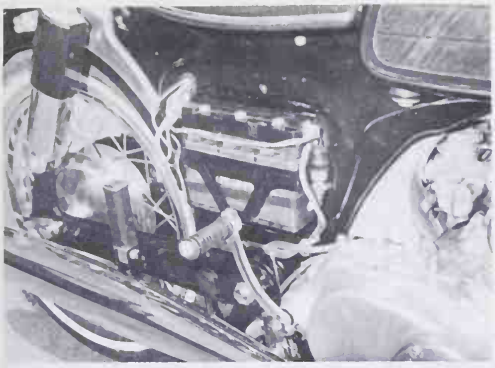
If there is fuel, or water, or a mixture, turn on the tap and see if gas flows through the carburetor in a steady quantity as it should. This is good to flush out the needle valve seating anyway.

On the Keihin carburetor, such as is used on the larger Hondas, flip the wire retainer down and remove the float bowl bottom. Late models have a carburetor bowl drain screw. A twist of the screw will reveal the presence and character of fuel.

At this point you have proven that there is spark at the plug and fuel at the carburetor. So, the only reason the engine won't fire must be mechanical.

Before we go farther, and before you put the plug back in the hole, take a pencil, pen or other slender, long object and push it in the spark plug opening until it rests on the piston. Then push the

Battery, fuses and rectifier are located under the cover on right side on the Honda 90.



Twelve volt battery is fitted to 160 and larger model Hondas. Access is via right hand cover.

kick start lever down slowly and observe the movement of the pencil. It should move up and down. If not, the clutch is slipping and all of your kicking is for naught.

With the plug removed it is an opportune time to take a compression check. (If you don't have a compression gage, you are at a point where a visit to your friendly motorcycle shop is required anyway.) This is a tricky operation for one man, unless he has the proper long-tube gage (or three arms), but the requirements are as follows: ① Remove spark plug from second cylinder if it is a twin . . . to prevent accidental runaway at full chat. ② Open throttle *fully* against the stop. ③ Depress starter vigorously three or four times while holding compression gage firmly in plug bore.

If compression is low, suspect a bent or burned valve or poor valve seating. If it is nil, or extremely low, a holed piston is probably the cause of your trouble. "Low" is a relative term, to be sure, but the average four-stroke engine should operate after a fashion on 80 psi compression.

For verification remove the rocker box cover, or gain access to the valve clearance adjusting position as required, and check the valve clearance. A very loose valve is probably bent; a very tight valve is probably burned.

Before you panic, adjust the valves to proper clearances and try to get the engine to run. Poor adjustment *can* prevent an engine from starting. (See TUNING, P. 86.)

Likewise, if compression is quite low and you want to be sure that things are as bad as they seem before you pull the cylinder you can use a small bayonet bulb, such as those fitted as instrument or indicator lights, to help out. Take the bulb, solder a wire to the tip, another to the brass base and connect the two wires to a battery. This light is small enough to slip through the spark plug hole and illuminate the interior of the cylinder—a feat which is not possible with any other source of light.

If you want to rotate the engine to bring the piston up for a closer look, don't use the starter. Put the transmission in top gear and revolve the rear wheel slowly.

All of this can bring you to two conclusions: ① somewhere along the line electrical or ignition problems beyond the scope of this chapter were discovered. ② The engine is sick.

THE ENGINE IS HARD TO START— OR RUNS ERRATICALLY

The basic assumption here is that we are not just dealing with a tired engine, one which is crumbling into ruin or held together with wire and hope. If such is the case, it *should* be hard to start. Rather we assume that the bike is in normally good operating condition and that ① it either becomes hard to start and runs erratically suddenly, or ② the condition has been getting progressively worse for some time.

In either case: ① Check the electrical system —paying particular attention to the battery if it is a part of the system. All connections, it must be stressed, have to be clean and tight. In the Honda system a low-charge battery makes for a poor running engine, so suspect it first. It is easy to leave the ignition or lights on and the battery is quickly discharged to a low state.

② Check the spark plug for type and condition. Perhaps the wrong heat range is being used, or another engine condition can be diagnosed by

Hold spark plug against head to make good ground and kick starter lever to check for faulty ignition or bad plug.

Open fuel tap and check quality of fuel as it flows onto rag or into container.

Small vent hole in Honda gas cap can become plugged and cause difficult starting or poor running, especially at high speed.

examining the plug. See the TUNING section for details on plug type and analysis.

③ Check the carburetor idle mixture screw. This often becomes maladjusted because the owner doesn't watch what his hands are doing while gripping a screwdriver.

④ Check ignition timing and correct if wrong. This cause of hard starting and erratic running is gradual in its onset, rather than sudden, because it is due to the wear of the cam fiber which causes a variation in point gap. So, if sudden hard starting is the case a more likely suspect is the capacitor. Replace it if points are burned and discolored, which is a good sign of a faulty condenser.

⑤ This brings us to bad points: worn, dirty, pitted or oily. Dress them or replace (preferably) with a new set. If the breaker point area is oily, somewhere there is a bad oil seal in the drive. Replace it.

(On straight magneto models, inspect the pickup and slip ring for dirt and grease and correct the condition if necessary.)

⑥ If the engine kicks back on starting, chances are the automatic advance mechanism in the distributor is not working properly.

⑦ Check the air filter. Remove and clean it. If it is ancient and excessively dirty, get a new one.

⑧ A clogged muffler can cause hard starting. If the bike is a high-mileage job or is an oiler, suspect this cause right away. If the diffuser is removable, clean it.

⑨ If the machine has been stored and has been put into use without proper attention to preparation, the carburetor idle jet can be clogged with varnish or gum residue. The main jet can likewise be plugged with this substance. Acetone is a good solvent, or regular carburetor cleaner such as that used in motorcycle shops can be used.

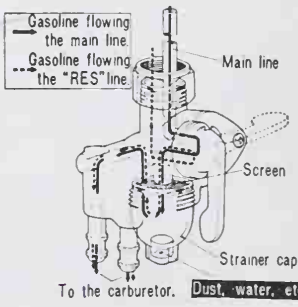
ENGINE DIES WHEN THROTTLE IS OPENED

This condition appears to cause some concern to beginning riders and, while it can be due to engine problems, the most common reason for such performance is that the throttle is opened too widely too suddenly.

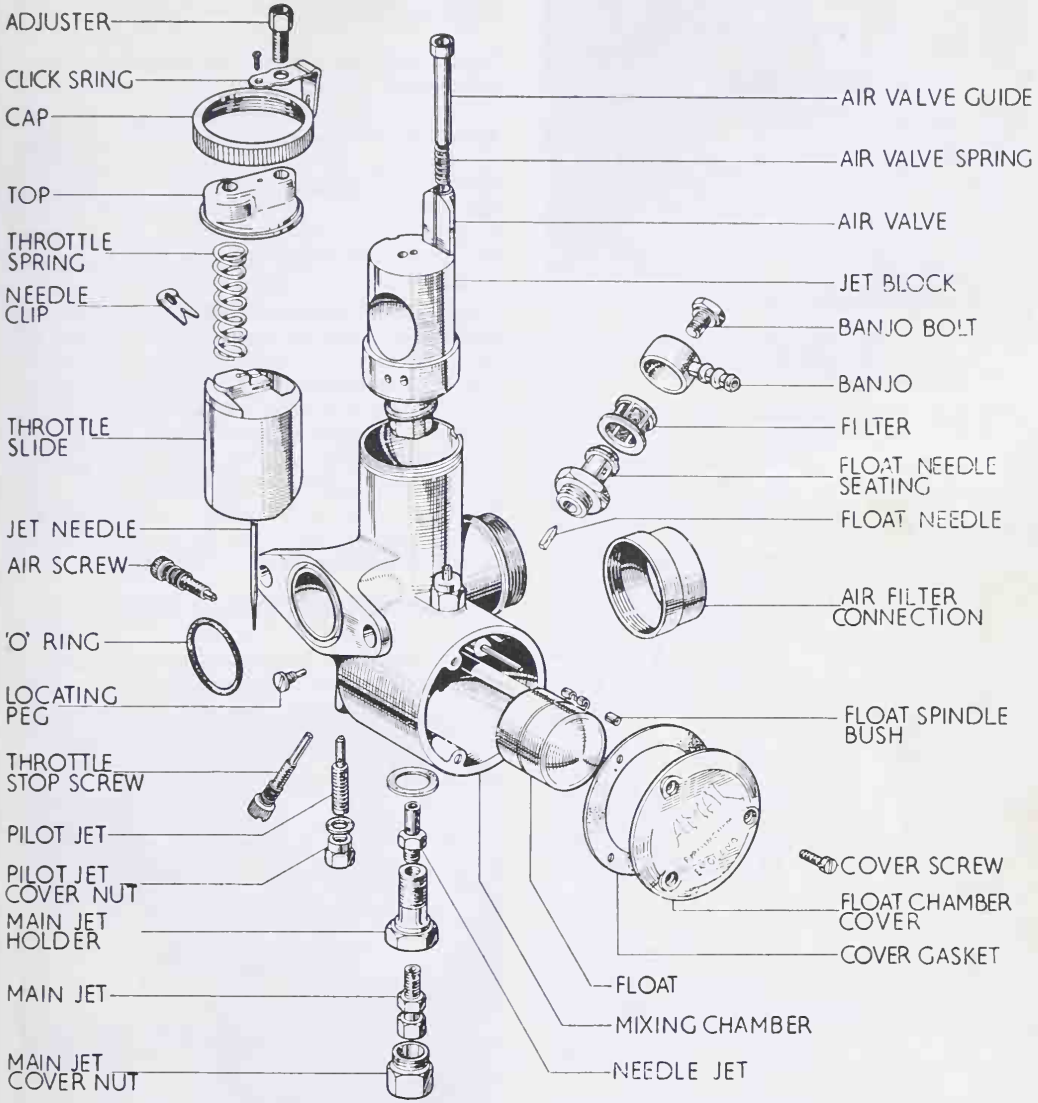
But, assuming that you are not being overly quick with the twist grip, this sort of death or slump of the engine can be attributed almost wholly to carburetion.

① Make sure that the choke lever is actually operating to open the choke fully when it is supposed to.

② Is the idling speed set high enough to accommodate a sudden increase in venturi area? If you have the engine ticking over at 200 RPM, it just can't induce enough pressure drop at the jet to suck up enough fuel.



Operation of Honda fuel tap and filter-trap.



Exploded view of Amal Monobloc carburetor.

③ How about the idle jet? Is it clogged?

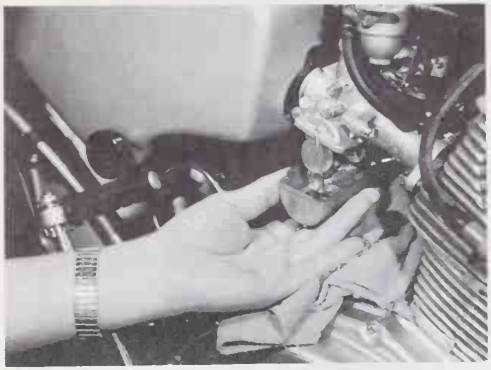
④ The whole carburetion system can be too rich. See TUNING section for setting idle speeds and mixtures.

⑤ This isn't likely but it can happen: An air leak at the carburetor flange which has been compensated for by jetting and lets the engine run, but reduces the vacuum. Squirt gas from an oil can around the attaching point and note whether the engine speeds up. This is a kind of last-resort suspect for this condition, but it is not uncommon in event of the following:

MISFIRES ON ACCELERATION

A: From low speed

If the engine is dropping shots under acceleration just off the line, but running satisfactorily otherwise, the odds are that carburetion is the villain.



Bottom of carburetor fitted to bigger Hondas can be removed by flipping wire retainer at side.

The first thing to examine is the idle mixture. The classic symptom of too-rich low speed mixture is misfiring on application of throttle. This is accompanied by a lumpy idle. Be sure the enriching for low speed is not overdone. Check the exhaust for black smoke, etc.

Don't overlook the fact that there can be water in the carburetor float bowl which is sucked up at the start before the fuel can be replaced. Water can also be present in the mesh strainer and trap on some models.

A clogged air cleaner can cause misfiring, but it will generally also show up as poor performance throughout the range, too.

A bad spark plug, where the ceramic portion is dirty and causing flash-over, can also be responsible for this occurrence. Where high voltage is being fed into a system it chooses the easiest way to go and a dirty plug is an open invitation to a direct-to-ground short.

B: At a given RPM in any gear

If the misfiring occurs at a given RPM, no matter what gear you are using and no matter what the throttle opening, suspect the automatic spark advance mechanism in AC magneto systems. This can be going out of phase at certain RPM. On battery systems the ignition may be out of time. Over-richness can also be causing "eight cycling."

C: At a given throttle opening, regardless of RPM

If the dropping occurs at a certain point in the throttle sector regardless of the Rs being turned by the engine, this is poor carburetor tuning or a bad needle, perhaps one which is nicked or damaged.

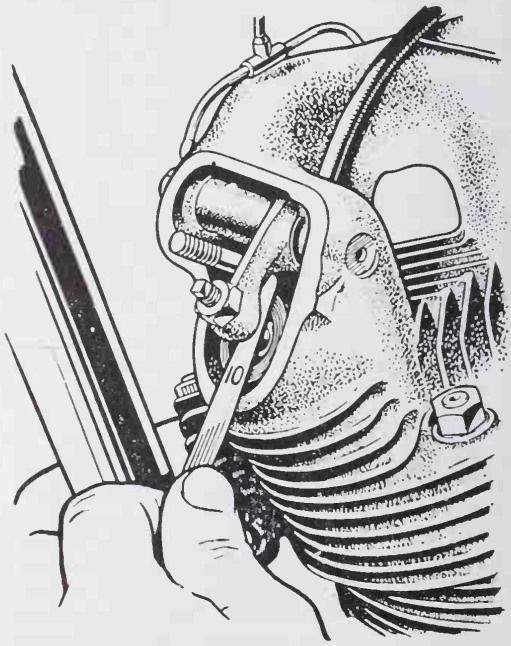
D: At no consistent throttle opening or RPM

Inconsistent misfiring is ordinarily due to malfunctioning in the electrical system. Go over the bike from stem to stern sparing nothing from your rigorous scrutiny. Plugs, points, connections, high tension lead to the spark plug, capacitor, battery—the whole works can be individually or collectively responsible. The important point is to overlook nothing. For example, on some British bikes a bad connection at the headlight shell or ammeter can cause the engine to misfire or quit because it is a link in the system!

MISFIRES UNDER LOAD

This heading is meant to describe a condition something like this: You are riding along serenely and approach a hill. You open the throttle and

Checking compression using special tube-fitted gage.



Using feeler gage to check valve clearance on Triumph.

as you mount the slope with the engine putting out its best efforts, it begins to drop a few beats. Gearing down, or returning to level road clears up the misfiring.

First diagnosis of this condition is that the plug is breaking down from overheating. The wrong plug is being used or gap is wrong.

Second choice would be, again, dirty air cleaner.

Too large a main jet, with insufficient pressure drop at wide throttle opening and relatively low speed, results in improper mixture. Tuning is indicated.

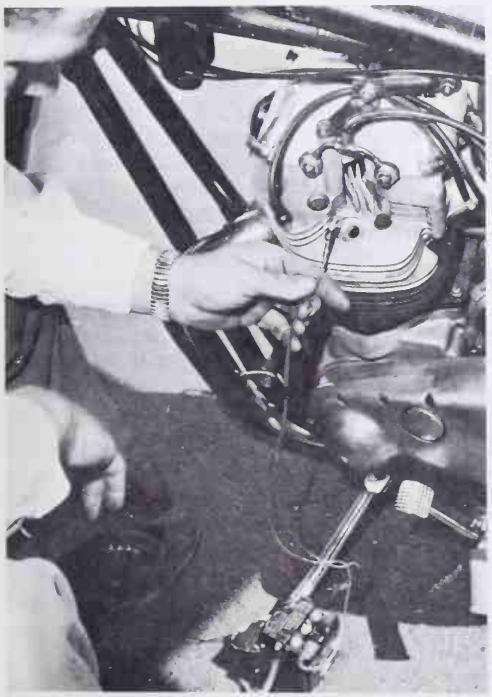
Poor fuel can play a big role in this sort of performance. Premium fuel, as recommended by the manufacturers, should be used at all times. "Cheap" gas is poor economy.

Improper timing would be about the fifth item in line to be considered. Spark timing becomes more critical as the load increases.

Finally, and not to be overlooked: Is the gear being used too high for the conditions encountered?

MISFIRES AT HIGH RPM

Dropping at high Rs is sometimes mystifying because so many facets of engine tuning are involved. Before going into them, it is first wise to establish that valve float is not responsible. Some riders twist their engines right up past the redline and never realize that the valves are crashing. And, the modern engine is so sturdy that it can take a certain amount without disintegrating, so these people never learn—until too late. At over-rev peaks valves are hurled off their seats at such acceleration rates that the return springs cannot control them and they stay open too long, then crash down after the cam has turned past the ramp. The prolonged opening period destroys critical valve timing and causes a dilution of the fuel charge and thus the misfiring.



Using small light bulb to view inside cylinder through plug hole. Bulb, soldered to wire, is about to be inserted.

Examine snap connectors at all points for corrosion and looseness.

If this isn't the cause, then you have a wide choice of possible other causes.

① Since the main jet, without being influenced much by the needle, is responsible for mixture control at high speed, it should be looked into first off. Follow the specifications in fitting this important component . . . or adjust according to tuning information supplied in other parts of this book.

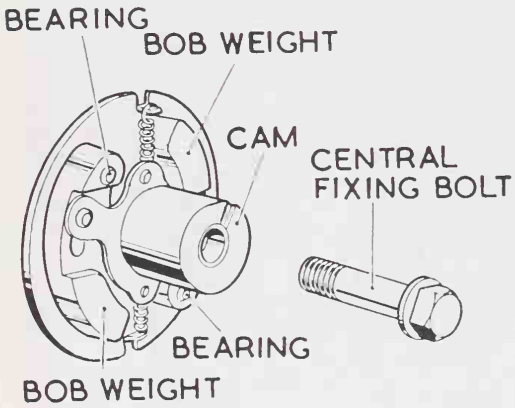
② Believe it or not, that old dirty air cleaner crops up again in this situation. Check it.

③ Improper float level is a common cause of high speed misfire. Set too low, the float does not permit sufficient fuel to accumulate in the bowl to serve the needs of the carburetor.

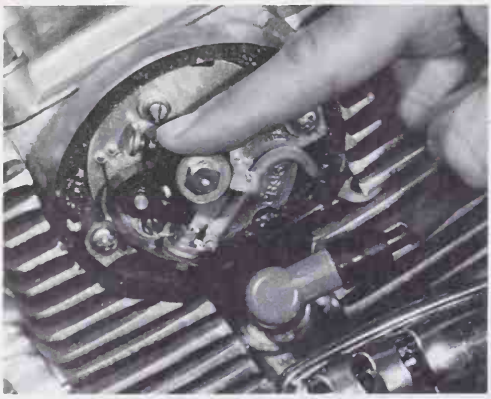
④ Spark plug: dirty, wrong heat range, improper gap, faulty. Any or all of these plug faults can be responsible. High pressure breakdown of a seemingly good plug can also be the trouble. Heat range is pretty critical in air cooled engines. If the plug is too cold it shorts out, if too hot it welds. If the gap is too great the cylinder pressure prevents the arc from forming across the expanse between the electrodes.

⑤ Bad capacitor. Especially on the AC mag-

Late model Hondas have drain screw at bottom of carburetor for checking fuel.



Automatic advance unit (Lucas) typical of most ignition systems using coil.



Examine breaker points for condition when hard starting or erratic running is the symptom.

neto system, a poor capacitor can perform satisfactorily at low speeds yet fail to prevent point arcing at higher Rs. Have it checked or substitute a new one if everything else is right.

⑥ Coil. Same situation as with capacitor.

⑦ High tension leads leaking. Be sure the plug wire is not leaning on metal which would invite a direct ground. Rev the engine up and run your fingers along the plug wire. You'll feel a tingle if there is leakage.

⑧ An air leak in the exhaust system, where the pipe joins the head, will cause high speed dropping. This is also accompanied by "banging in the silencer" as our British cousins say.

⑨ Air leaks at the carburetor are another possibility. Follow recommendations at ⑤ under ENGINE DIES WHEN THROTTLE IS OPENED.

⑩ Slightly burned or bent valve.

⑪ Improper valve clearance. These two items can cause high speed misfire, but they should also make their presence felt in other ways, so this symptom (misfire) should be considered as additional evidence leading to a conviction, rather than a definitive single issue.

⑫ Clogged or restricted exhaust should always be suspected if bike is older or has had poor maintenance.

⑬ In case it has been overlooked somehow, check the choke. Be sure it isn't being put into operation.

POOR LOW SPEED PERFORMANCE

This symptom is presumed to be apparent as stumbling or lack of power at low Rs which clears out in the upper range of the engine. This is not to be mistaken, of course, for the loading-up which occurs at prolonged idle and which disappears as soon as excess fuel and carbon are blown out, but rather a consistent lack of performance in the bottom half of the power curve.

Number one trouble-causer in this situation is improper carburetion: Wrong idle adjustment, wrong needle setting, etc. Tuning is the answer.

Second, and not too far behind in frequency, is improper spark advance. Between these two, you'll find the trouble in most cases.

POOR HIGH SPEED PERFORMANCE

Complaints here are a lack of power at what should be the peak torque of the engine, reduced top speed and the need to shift down more frequently. Actually, in most cases, the rider just doesn't notice it but there is a general lack of power throughout the range of the engine. It is only that it becomes most noticeable when more is asked of the engine. However, if it is clearly

only the top end:

① Again, wrong carburetion adjustment is the prime suspect.

② Dirty, clogged or bad air cleaner. This condition can be borderline, permitting enough air flow to take care of low speed operation but causing an over-rich condition at full demand.

③ Ignition timing and cleanliness of ignition system play a big part in top-end performance.

④ Spark plug and wiring.

See MISFIRES AT HIGH RPM (above) for more details. The engine can drop off in power yet apparently be hitting on every power stroke.

⑤ How is the battery? Don't overlook this link in the system if it is intended to complete a circuit of which the ignition is a part.

⑥ Weak valve springs. On an older cycle or one which is somewhat tired, this condition can prevail with this sort of result. Usually accompanied by some misfiring, however.

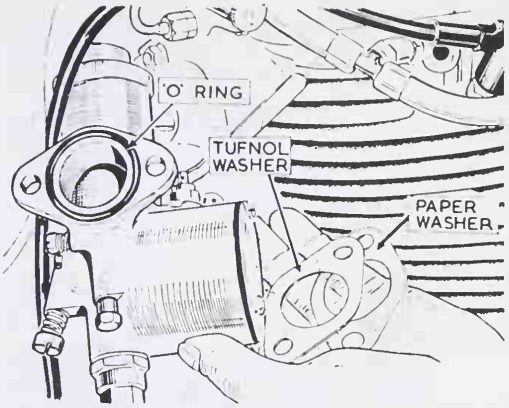
⑦ Lack of compression. Poor mechanical condition with worn rings, valves in need of grinding and so on shows up first as lack of top end performance.

⑧ Is the rider too heavy for the machine? Maybe the load capacity is being exceeded. A 300 pounder on a 50 cc. Honda can't expect blazing performance.

⑨ Is it a slipping clutch? Could be. See CLUTCH AND TRANSMISSION section.

⑩ Tire pressure check. Low tires cause increased rolling resistance which is noticeable, particularly on small displacement cycles.

⑪ Partially plugged tank vent.



Carburetor mounting gaskets which can cause trouble via air leakage.

POOR GENERAL PERFORMANCE

Under this heading, naturally, can be lumped any single cause or combination of causes conceivably connected with the engine . . . and for that matter other portions of the bike. But let's run through the most common causes, in order of their frequency.

① First suspicion should fall on the ignition timing. If it is off the engine is just hopeless in performance.

② Spark plug. Improper type, fouled, dirty, etc.

③ Poor carburetion. Symptoms of over-richness or too-lean a mixture are easy to detect by examination of plug and exhaust pipe. See TUNING (P. 86) for clues.

④ Is the bike running free? Check the rear wheel as the machine sits on the stand. Does it turn over easily? Is the brake dragging? Are wheel bearings bad? Is the chain too tight? Any of these items can slow the bike so much that the tendency is to suspect a poor-performing engine.

⑤ Slipping clutch. This should be an obvious condition to even a novice rider, but a surprising number of people don't notice it.

⑥ Improper valve adjustment, burnt or bent valves can reduce horsepower. Check these items out as directed under THE ENGINE WON'T START.

⑦ Tired. Poor compression is the clue to the mechanically-ailing engine. Without good compression you can't have good performance.

⑧ Is the sump loaded with oil, by any chance? Too much oil collecting in the crankcase will slow an engine down considerably.

OVERHEATING

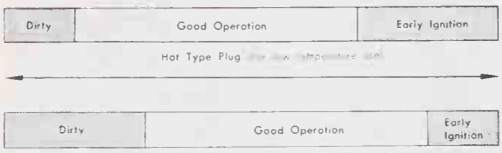
The air-cooled engine is designed to be cooled by a *moving* stream of air. This means that the machine must be moving to insure that the designer's aims are carried out. Oh, sure, your motor will sit there and bang away without complaint for several minutes, but it isn't a good idea to prolong idling, or operating while the bike is at a standstill. So don't expect it to be happy. If this is the "overheating" complaint, all that's needed is a change of habit.

However, if the engine overheats under normal riding conditions—that is, it begins to lose power, misfires or starts to seize up, then you must assume that there is a malfunction or a poor operating condition.

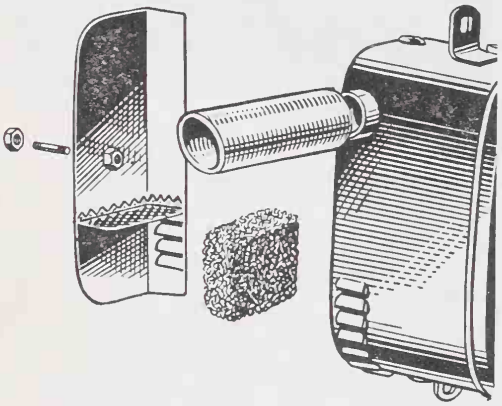
① Too lean a mixture is the commonest reason for overheating on the road.

② Next commonest reason is improper ignition timing. Insufficient advance is the problem.

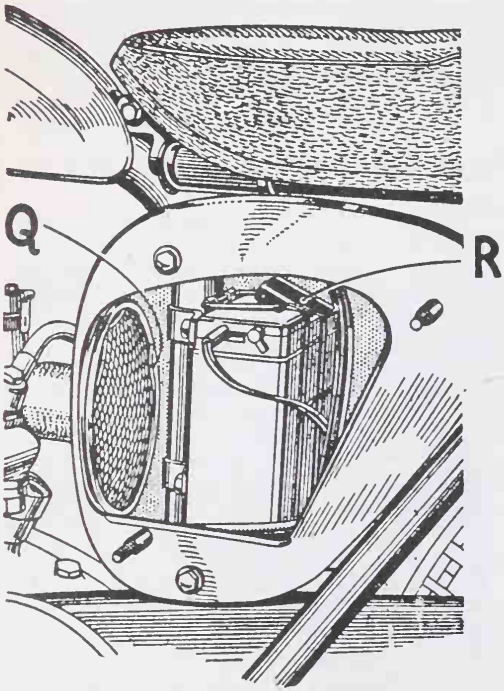
③ Wrong heat range spark plug can also produce this condition.



Graphic illustration of plug characteristics.



Dirty, choked air cleaner filter is responsible for many performance complaints.



BSA air cleaner location.

All of these conditions can be dealt with in the tune-up process. If the engine is tuned properly and it still overheats, then look to one of the following:

④ Air leak between carburetor and head—resulting in an excessively lean mixture, and most noticeable under load. This may not be enough to cause misfiring, but that could be a clue.

⑤ Not free-running. See ④ under POOR GENERAL PERFORMANCE.

⑥ Low oil level. The air-cooled engine is also cooled by oil. A full manufacturer's recommendation supply should be carried.

⑦ Improper oil viscosity. A higher viscosity oil is required for hot weather. Do you have the proper grade in the sump?

⑧ Is bike's capacity being exceeded? Overloading is immediately productive of overheating.

⑨ Is the engine dirty? Cooling fins, particularly, and the rest of the motor casting generally, must dissipate the heat generated by combustion and friction. If there is a film of dirt and oil on the surface, dissipation is retarded. Gunk it. Remember: A clean bike runs better.

MISCELLANEOUS CARBURETOR PROBLEMS WHICH CAN CAUSE HARD STARTING OR POOR PERFORMANCE

① The main jet cap on many carburetors acts as a sediment and water trap.

② If the small brass spacer is left off the float support spindle on Amal Monoblocs the float will move allowing the needle valve to drop into the bowl and cause flooding.

③ Bent needles can upset air fuel ratio. Fuel consumption will rise if needle is worn.

④ "O"-ring gasket on Amal type carburetors can fail or be pinched on assembly and permit air leaking.

⑤ Warped flanges will not seal against head and permit air leak.

⑥ A small amount of water retained in line filters at banjo can cause prolonged difficulty.

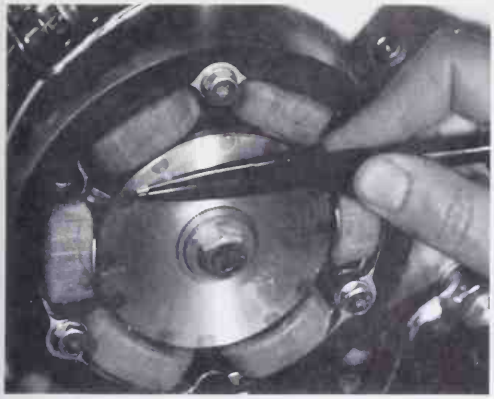
⑦ A carburetor which has been mounted rigidly, instead of with flexible mounts as originally fitted, can cause fuel frothing and a mysterious misfiring.

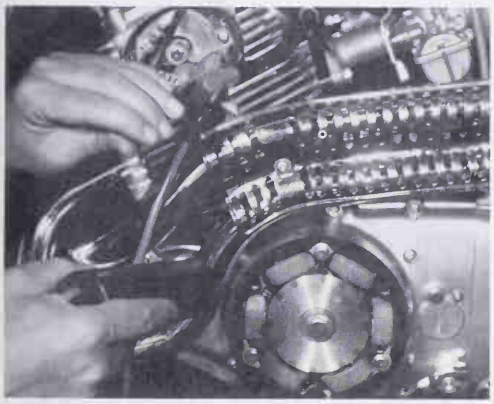
⑧ Incorrect float level should always be suspected in case of poor high speed performance.

OTHER ENGINE PROBLEMS

Excess oil consumption

All engines use oil, even four strokers, so expect the consumption of a certain amount of lubricant. The greater the clearances in the engine, the more oil will be used. Even if the high-miler is clean externally, it will absorb. The leaky bike runs through even more, naturally. But there is a





limit and if consumption exceeds the norm, by all means look into the problem.

What is normal? It is impossible to say. The use of oil varies so much with model, displacement and condition that any given figure would be inaccurate. However, the clues to excessive oil burning are plain if you examine the spark plug and the exhaust pipe. A wet, black plug is indicative of oil burning. A gray smoke from the exhaust (as opposed to a black smoke which comes with over-rich fuel mixture) is another sign. An exhaust pipe coated with heavy, sooty deposits is another indicator.

If all these are present and accounted for there may be one of several things wrong.

① Are you using the right grade of oil? If the oil is too light for conditions (either riding or engine wear) a lot of it can blow right out the exhaust pipe. Go up a grade and see if it helps. Drain and refill, of course.

② How is the compression? Worn rings permit the passage of crankcase vapors, which are heavy with oil, into the combustion chamber where they are burned. A compression check will disclose this condition.

③ Is the oil being returned to supply? On dry-sump engines this is critical. Check the screen and the return line from sump.

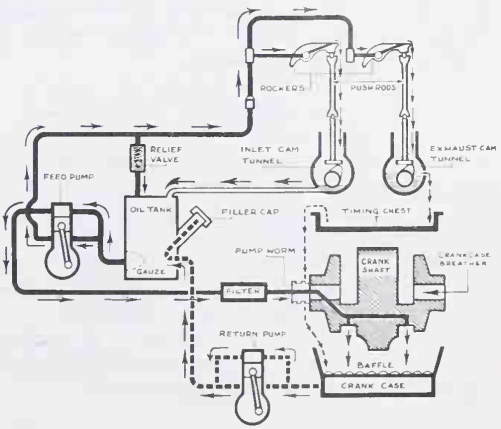
④ Check the sump breather. If it is plugged, excess oil will be burned.

⑤ Bad valve guides, with excessive clearance between valve stem and guide bore, are responsible for a certain amount of oil burning. If compression checks out well, but other symptoms are present, measure stem-to-guide clearance by applying side-to-side pressure on valve stem with spring removed. It should not rock.

Lack of oil pressure—sudden

This isn't a symptom, it is a problem. The symptoms would have manifested themselves as mechanical difficulties because, except in the rare instance of a model equipped with an oil pressure indicator, there is no visible clue to a lack of lubrication at critical points fed by the pump.

Pressure failure generally means pump failure because of accumulated debris in the check valve in the plunger type pump. This is easily cured by removing the retaining screws, spring and ball in the check valve and cleaning the seat with solvent. Rarely, on some models, does the drive break. In some types, such as the small displacement Hondas, with semi-pressure lubrication to the rocker box, the grooves in the cam which feed oil up to the top of the engine can become clogged with muck if the engine is neglected long enough. Remove the rocker oil feed bolt (see illustration) and start the engine. There should be a steady flow of lubricant.



Schematic diagram shows circulation of lubricant when separate tank and dry sump system is used. This is Royal Enfield, but typical of others.

Lack of oil pressure—gradual onset

Again, if there is no pressure indicator, this is not something the rider would be aware of. If there is an oil pressure gage in the system and pressure begins to drop or falls off more than usual when hot, look to excessive clearances in the parts supplied under pressure: connecting rods and mains.

Lack of return to tank

This problem is accompanied by the symptoms of heavy exhaust smoking and other signs of overoiling since the lubricant is accumulating in the sump instead of making its way out. The problem is generally right in the return pump with sheared drive, bad check valve, loose pump mounting, failed gasket, etc.

A second possibility is that the pressure pump has failed for some cause. In this case, there would be no smoking, but the symptoms of no oil pressure would be present.

On BSA twin models, remove the sump plate and free up the anti-syphon ball at the bottom of the pickup by lifting it with a small screwdriver or suitable instrument. A sticking ball is a "sometimes"-happening.

VIBRATION

Excess vibration is usually directly traceable to loose, broken or worn motor mounts and all mounting points should be inspected *carefully*. The emphasis on the last word is because a mount plate can be fractured *under* a bolt head and thus be concealed.

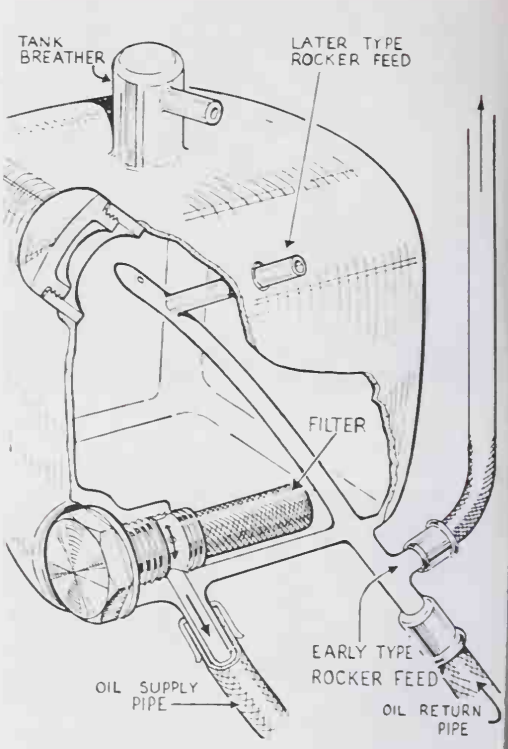
Incorrect clutch assembly, poor timing, worn crankshaft are other possibilities, but they are fairly easy to trace since the onset would either be gradual (in the case of the crank) or following some tinkering. If the bike is new to you, a thorough inspection of all these possible causes should be carried out since vibration is usually a prelude to some sort of failure.

NOISES

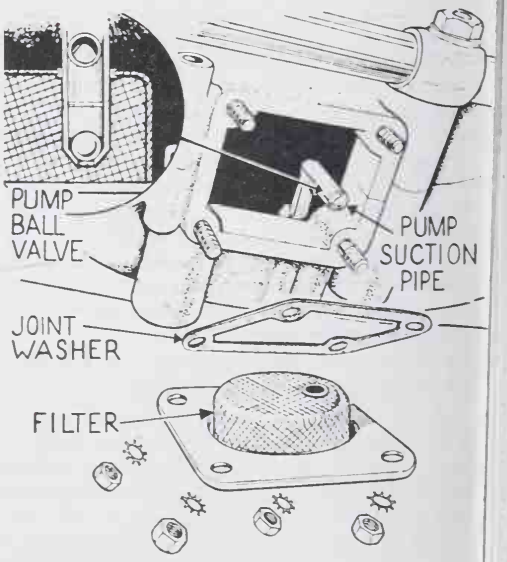
Noises from an engine can be both annoying and meaningful. Each engine has its own particular set of normal noises and the rider should get used to them. Then when there is a variation, no matter how slight, he is alerted. Some small noises have little significance other than to denote ordinary wear and changing of clearances . . . valve clearance, etc., but loud, heavy or sudden noises generally come as a clap of thunder before the storm, warning of heavy weather.

Pinging

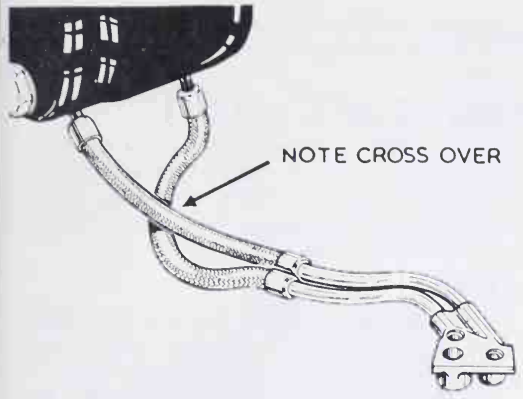
This is a high-pitched, upper cylinder rattle at one half engine speed and is caused by pre-



Cutaway illustrating differences in early and later BSA 500-650 oil supply.



BSA 500 sump details.



Hose connections of BSA tank.

ignition (detonation) of the fuel charge. It occurs most noticeably on acceleration or under load and is brought on by one of several things. Principal cause is low-test fuel. Using a poor grade (low octane rating) gasoline in a high compression engine is an open invitation to this symptom.

It is more than annoying; detonation is harmful to bearings and pistons. Switch to high test (premium) gasoline.

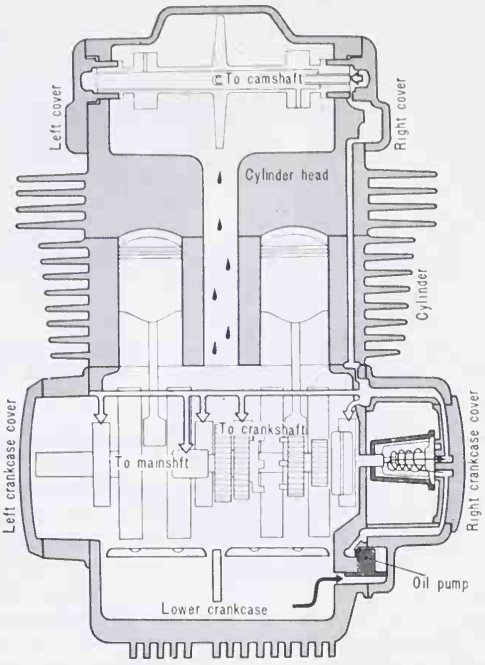
If you are using high-test gasoline and get the same sound, chances are, first, that the ignition timing is too advanced. If your model is a twin, be sure that both sets of points are opening at the proper time. Worn parts here can cause a variation between the two.

Another possibility is incorrect spark plug heat range, wherein the tip is overheating and acting like a glow plug in a model aircraft engine.

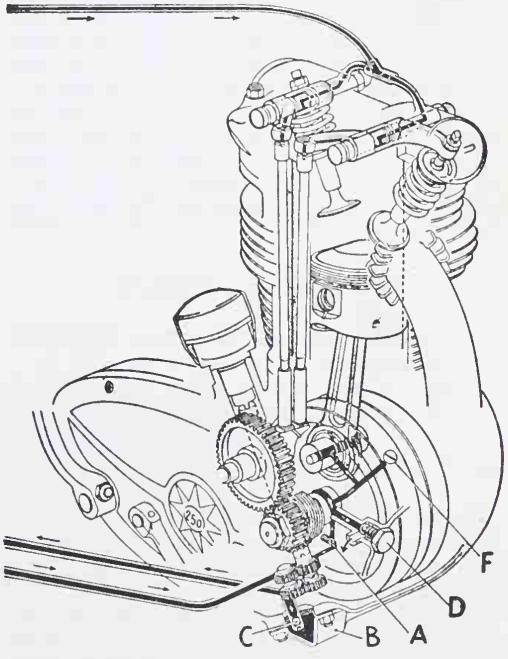
Still another cause can be excess carbon in the combustion chamber, or, if the engine has been recently overhauled, a bit of metal may have been left around the spark plug hole in the form of a broken thread which is heating and glowing. The latter three possibles should be considered more if the pinging occurs only after the engine is good and hot.

Clatter

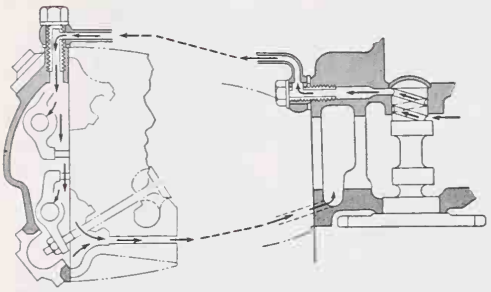
This is generally the description applied to excessively loose valve/rocker clearances. It is more noticeable when the engine is cold than when it has warmed up and is clearly in the upper part of the engine. There is a certain amount of valve noise in an air cooled engine, but if tappet clearance is even all the way through, no one valve stands out as being noisier than the others. A short length of rubber tubing can be used to listen to each rocker arm in turn and isolate the noisy one. A long screwdriver with handle held to the ear and tip against the rocker box can serve the same purpose.



Honda wet sump lubrication system (450 engine).



BSA 250 oiling method—note anti-syphon ball valve in sump (C) which sometimes sticks.



Semi-pressure oiling system, as exemplified by Honda 50cc, uses splash feed in crankcase, spiral groove on camshaft to feed upper cylinder components.

Clank or slap

Piston slap in the air-cooled engine takes on a more metallic ringing sound than it does in the water-cooled engine. So if you hear a half-speed clank, like bringing a piston and a cylinder barrel smartly together, chances are it is piston slap caused by excessive piston-to-wall clearance.

Slight noise, one that disappears after the engine is warmed up, can be tolerated, but one which hangs on should be investigated. To verify the cause, first determine if it is common to both cylinders if the engine is a twin, by removing a plug wire from each cylinder in turn. The non-firing cylinder should not make a distinct noise. Ride the machine at low speeds under load and see if the sound intensity increases as throttle is opened.

Rap

Descriptive of excess clearance in connecting rod bearings in most engines, this noise is most noticeable when the engine is running under a light load decelerating. It should also increase in loudness with speed.

Knock

This is a heavier sound than any described so far and comes from the bottom region of the engine, indicating that it is a main-bearing or crankshaft problem in those engines with plain bearings. Most easily detected when under acceleration or when starting.

Screech or whine

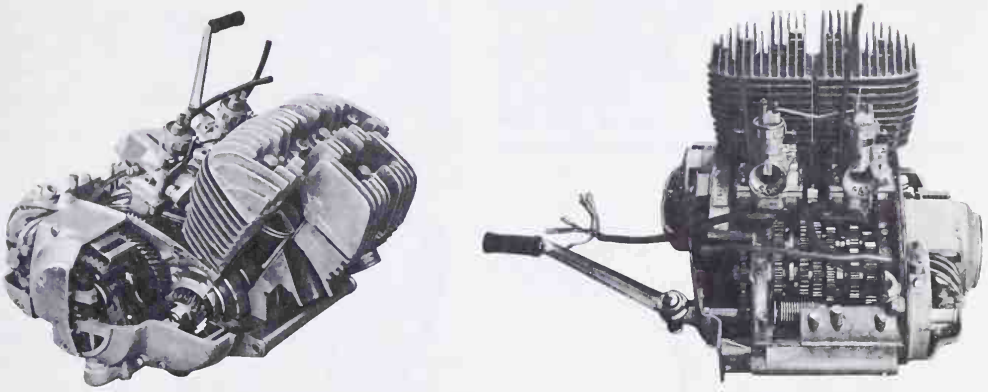
Since Hondas and others have ball and roller bearings supporting the crankshaft, the heavy metallic thump of a bad plain bearing is not a symptom. Instead a screeching, whining sound, like a faulty siren or the rear end of an old Buick, occurs when bearings go bad (very rare under normal circumstances).

Double knock

Symptomatic of excessive piston pin clearance. This is most noticeable with the engine idling and is a sharp, quick double-rap.

Chapter 2

The Two-Stroke Engine



Cutaway of Suzuki twin 250cc.

The two-stroke cycle engine is so basically simple that it seems there should be few causes of trouble. This is true. Like comparing an air-cooled powerplant to a water-cooled one, the two-stroker has much less possibility of going bad than the four-stroke type. The reduction in moving parts alone is enough to eliminate many potential problems. But this does not necessarily mean that a two-stroke is more reliable. The ills to which it is subject are often just as prevalent and, in the case of the rider, just as baffling.

It is assumed that the reader knows the essence of the two-stroke cycle principle. If not, reference to the accompanying chart will make the gas flow through the engine clear . . . and that's about all there is to understand. The carburetion and ignition of the two-stroke are shared with the four-stroker and, aside from lubrication, the configuration of the modern power unit (engine/gearbox together) is about the same whether the two- or four-stroke principle is employed.

This reference to the four-stroke is made because the average rider has at least a nodding acquaintance with the "conventional" engine so widely used in automobiles. If you are used to dealing with the valve-equipped type, you will find several pronounced differences in the two-cycle. If you have no experience with either type of engine, you can pick up enough hints here to make the various functions of components clear.

The biggest owner complaint is either that the engine is hard to start or it won't start. Other gripes or troubles dwindle away sharply in percentage below these two. Anyone who has fiddled with an old two-stroke outboard motor, a model airplane, or a model car engine knows the frustration of trying to get exactly the right conditions to make the things start and run. The modern two-stroke motorcycle engine isn't nearly so finicky, but all models have their bad moments and the best procedure, for amateur and old-timer alike, is to begin with the correct starting procedure as recommended by the manufacturer.

If you don't have the owner's handbook, or if the bike is strange to you, here is a procedure which will get any two-stroker going—if there is nothing wrong with it.

Run through it before you assume that something is wrong with the powerplant.

STARTING PROCEDURE

With cold engine or in cool weather

① Turn the fuel tap to the "on" position.

② Turn the key to the first notch or mark.

③ Close the choke. (Jiggle the carburetor tickler if so equipped.)

④ Kick the starter or push the electric starter button.

Note: Do not open the throttle while operating the starter, and resist the temptation to crank the throttle on as soon as the engine fires up.

⑤ As soon as the engine is running smoothly (throttle still closed), gradually begin opening the choke, and as soon as the choke can be reduced, open the throttle and speed the engine up. Gradually open the choke as engine warms up.

With warm engine or in hot weather

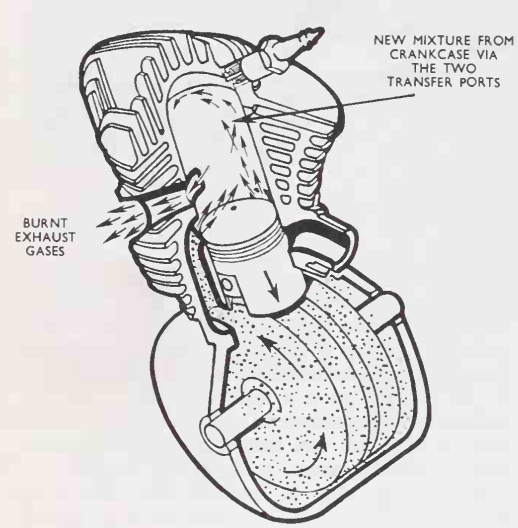
Following 1 and 2 above, leave the choke alone and open the throttle ⅛ to ¼ and kick the engine over on the starter.

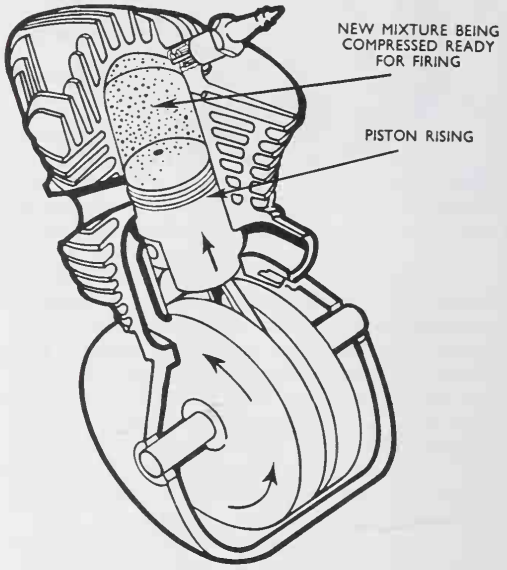
Seems simple, doesn't it? It is, but suppose the engine doesn't fire up right away. Suppose you have been kicking the starter for a considerable number of times and the only sound you get is your own panting. Then what?

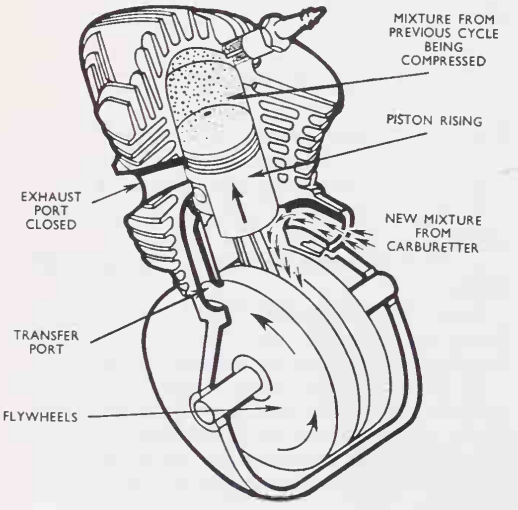
Then you've stepped into the twilight zone where anything in the world *could* be wrong, but chances are that only one of a few things is *likely* wrong. To find out what "thing" and how to proceed, it is necessary to follow a step-by-step method of eliminating items. As with a four-stroke, there is truth in the statement that if you have a spark and you have fuel and you bring them together under pressure at the right time, you'll have an explosion. So, either you have no fuel, you have no spark, you have no compression or you haven't got the right time.

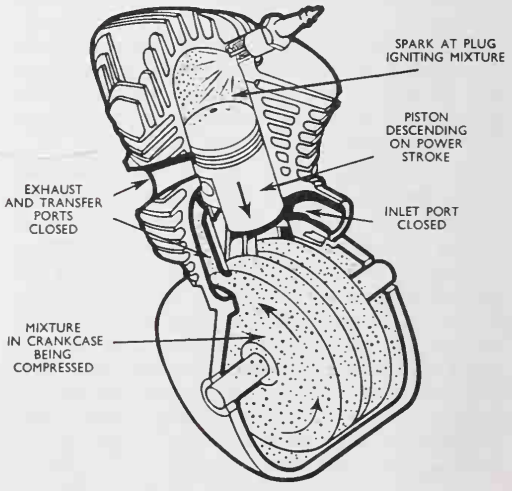
Bear up and follow through on the following:

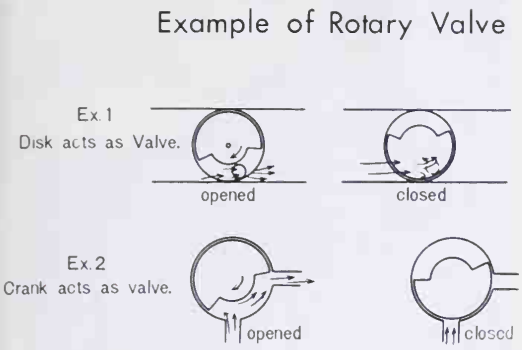
① ***If there is a smell of raw gas,*** or visual evidence of flooding such as fuel on the carburetor, open the throttle wide and kick the starter, or operate the electric starter to turn the











Operation of the rotary valve.

engine over several times and thus clear out the excess fuel.

② ***Is the key really on?*** Twiddle the key in the switch a bit. Be sure indicator lights are on or try the horn to determine if the necessary electrical current is present somewhere in the system.

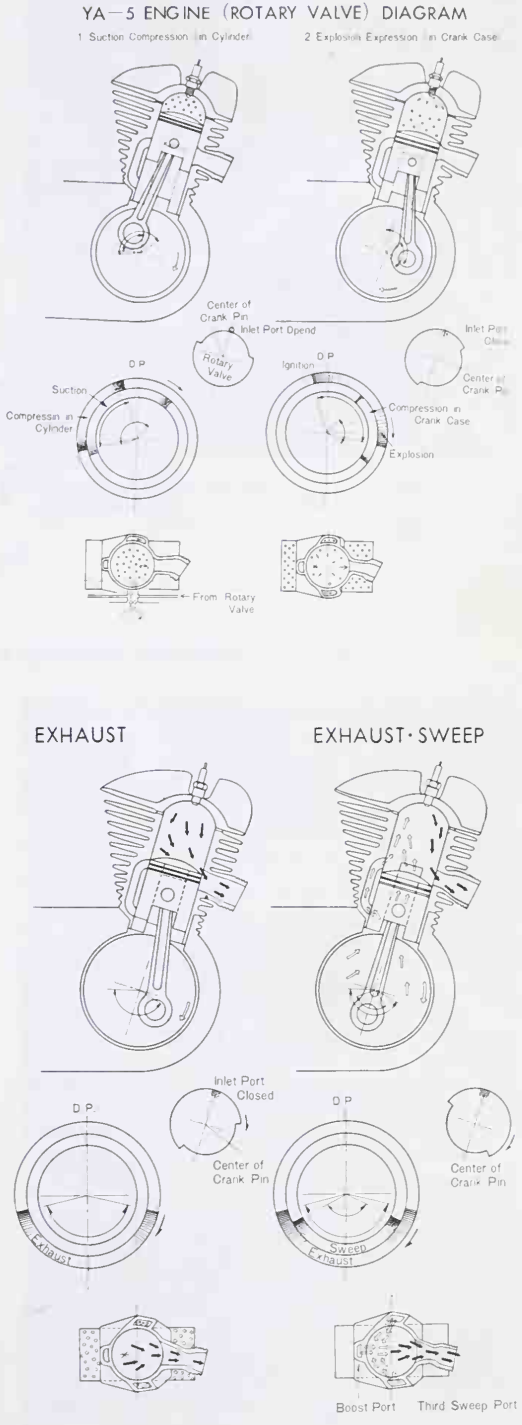
③ ***If there is an obvious supply of electricity,*** re-check the fuel supply. Switch to reserve. Turn switch to emergency start position (if present on your model) and try again. If the bike doesn't start now, further checks are necessary in the fuel supply, for which see below.

④ ***If indicator lights or other accessories do not function,*** suspect bad connections, blown fuse, or bad battery. For example, even though some bikes have an AC magneto system, a discharged battery in the circuit can make the bike hard to start and result in poor running. Check the fuses in any model. The fuses will vary in location but will always be close to the battery. Also check all electrical connections for cleanliness and tightness, particularly battery ground. This is highly critical.

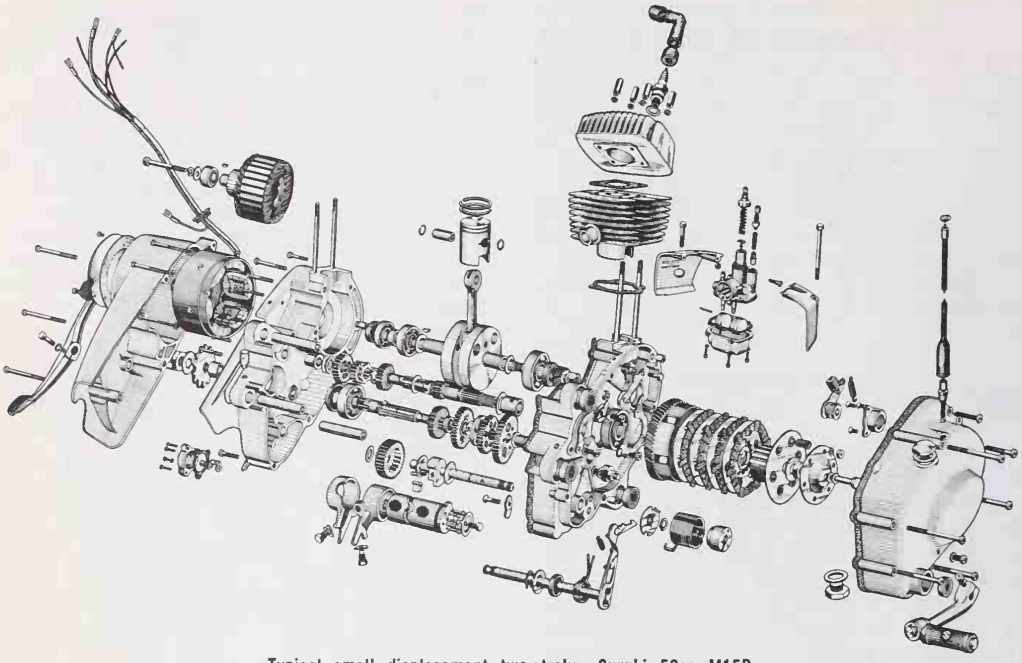
If fuses look good and connections seem in order, check the battery. The following advice will scandalize battery makers and it is admittedly not good practice, but you can satisfy yourself that there is current (or not) by striking a quick arc across the battery terminals with a piece of wire or the handles of a pair of pliers. Do this very briefly, just enough to get a flash.

⑤ ***If the battery is strong*** and a good spark results, examine the terminals, removing, cleaning, and replacing them if in doubt as to their ability to pass electricity.

⑥ ***If the battery responds weakly or not at all*** to the direct-short technique, either have it charged, switch to emergency starting position (if available), or push the bike. If a dead battery is the sole problem, most cycles will push start fairly easily. Cold weather and a big bike may make the process a bit difficult physically, but



Operation of the two-stroke cycle engine with rotary valve.



Typical small displacement two-stroke, Suzuki 50cc M15D.

the generating system on all models is designed to put out power at low RPM so this helpful feature which is not present in the automobile system works for you. *CAUTION: If you have the battery charged, read the section on ELECTRICAL SYSTEMS in this book before rushing down to the nearest service station.*

If after taking this precaution the engine still won't catch, it is time to check for spark at the plug. (We will use the singular to save words. If your model has more than one cylinder, mentally substitute the word plugs.)

① Remove the spark plug and examine the tip. It can be "bridged" with a tiny sliver of metallic deposits between the electrodes; it can be fouled with heavy, wet carbon deposits; the gap can be too wide or completely closed up. Or, the plug can be internally shorted. Clean the tip, or better, replace the plug with the one you thoughtfully packed into the tool kit.

② If the plug appears to be good and you think the condition of the electrodes shouldn't keep it from operating, replace the high tension lead, place it firmly against the fins of the engine head, and kick over the starter. You should get a fat, blue spark. If the spark is weak, check the electrode gap. In the two-stroke it should be .020″ to .030″. Anything above .030″ is too much. Less than .020″ isn't particularly critical. As a matter of fact, you can sometimes make a plug work by closing the gap right up. Set it down to .015″ or so and re-install it. The plug may be breaking down under compression and the closer gap will often permit it to operate until you can replace it with a new one.

If you don't have a feeler gage, take a paper matchbook and a business card. Together they total about .015″ in thickness. Adjust the plug gap so that this sandwich will just slide between the electrodes and the gap will be approximately correct.

③ If there is no spark at the electrodes and you are sure the grounding of the plug is good and that the high tension lead (plug wire) is firmly connected at each end, you've got ignition troubles. This may be a bad coil, bad points, or other electrical problems which are better covered in another section of this book. Just to satisfy yourself as to whether the system is functioning or not, grasp the plug in one hand and push the starter lever down politely. (Don't jump on it or your eyes are liable to light up like a pinball game.) You'll feel a tingle if the ignition system is developing output. If you get no indication of electrical energy, you've isolated the problem.

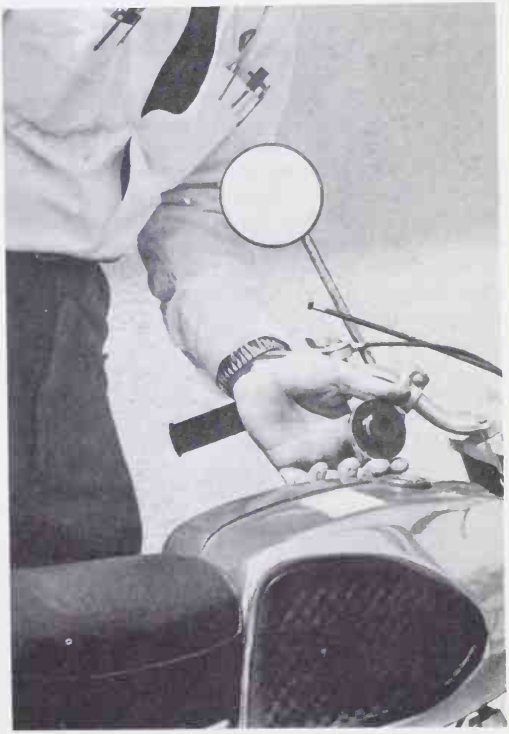
④ If the spark plug is good and you get a blue spark, there is a bare possibility that the timing is so far off the bike won't start. But chances are it is somewhere in the fuel system. Check the timing first as a precaution.

⑤ To check timing (roughly), put a pencil or other slender object into the spark plug hole; put

Is the fuel tap on? Has it been left on while bike was parked? If so, crankcase and carburetor could be full of fuel or oil.

Make sure choke is operating properly if hard starting is encountered.

Is the key on and switch making contact? Jiggle it about before assuming the worst. Switches of this type make a circuit to ground and can sometimes be ungrounded, by removal from mounting, to cure an internal fault.



Is there really a supply of fuel? And how old is it?

On many models it is necessary to take the battery out to get at wiring connections.

the gear selector in top gear and turn the engine over by rotating the rear wheel. Ascertain when the piston reaches the top of its stroke by watching the pencil. Then turn the wheel *backward* until the tip of the pencil is about ¼" below its peak point. Then remove the breaker point cover and examine the points. The points should be just breaking open. Be sure you have the set of points which relates to the right cylinder, if it is a twin. If the points open at some point in the stroke grossly removed from this amount of advance, then time roughly by this method or follow through as indicated under TUNING.

If you have cleaned the plug and there is a good spark, and the ignition appears to be in time, before replacing the spark plug, kick the starter lever a couple of times, or operate the electric starter briefly. Then replace the plug and try to start the engine. If the engine fires and runs only momentarily with a big cloud of smoke from the exhaust, the chances are the sump is loaded with fuel or oil. On most models you will find a small drain plug in the center of the bottom of the sump to permit the drainage of such unwanted liquid. It may be necessary to kick the engine over a couple of times with the plug out to achieve the desired result. Then re-examine the spark plug.

⑥ Check the fuel supply. Pull the fuel line off at the tap. Then, holding a rag or a container under the opening, turn the tap back on and observe fuel flow, if any. You can also observe whether you really have gas in the tank or some other liquid, such as water. Also, if the bike has been in storage for some time, the gas can have decomposed to such an extent that it won't burn. The highly volatile elements that make for quick starting in a fuel blend vaporize readily. This makes old gas equal to bad gas. It generally has a strong, pungent odor as opposed to the keen, light smell of fresh fuel.

In those models which use a fuel-oil mixture, you might get a lot of oil and little gas. Mixed fuel/oil does not separate but, in storage, the gasoline can vaporize, leaving oil or a too-rich mixture in the bottom of the tank.

Water is easily recognized because it balls up in droplets on the rag while gas soaks right in. It also sinks to the bottom in a container.

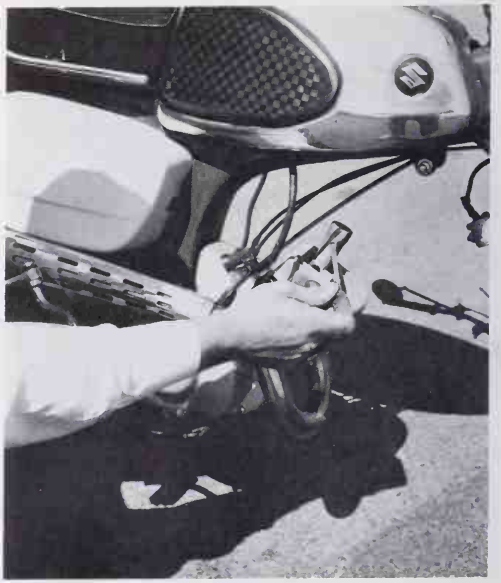
⑦ If the fuel flows for a moment and then stops, remove the gas tank cap and see if it starts again. If it does, this is the symptom of a clogged vent. Depending on the model, the vent is in the cap or in the tank. Find it and unplug it.

⑧ If fuel flows freely, or if it is obviously dirty, rusty, or full of sediment, there will be trouble farther along the line. So, remove the fuel line at the carburetor, take out the wire gauze strainer at the banjo, if so equipped, and clean it.

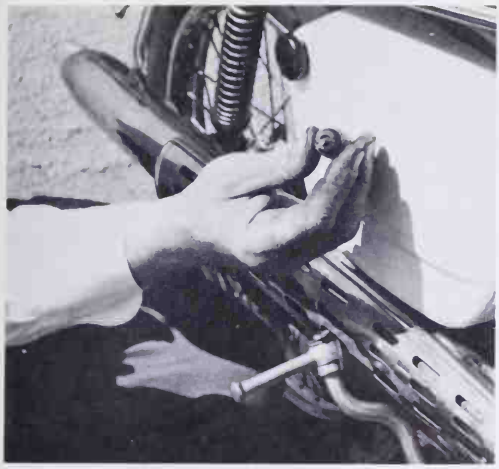
At this point, if there is fuel at the carburetor and the plug was good and not wet on examination, try heavy choking. Make sure the choke is really working. Then, if it doesn't start, get into the carburetor lightly.

⑨ If fuel is present at the main jet, and you have a spark at the plug at approximately the right time, and the engine still refuses to come alive, it's likely you've got insufficient compression.

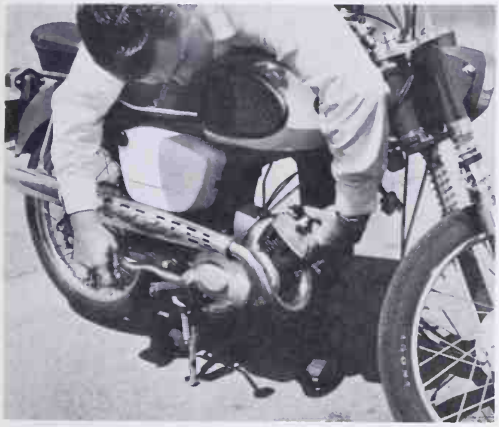
This means a broken piston, holed piston, blown gasket, leaky sump or something big. To check it out, take a compression check. The



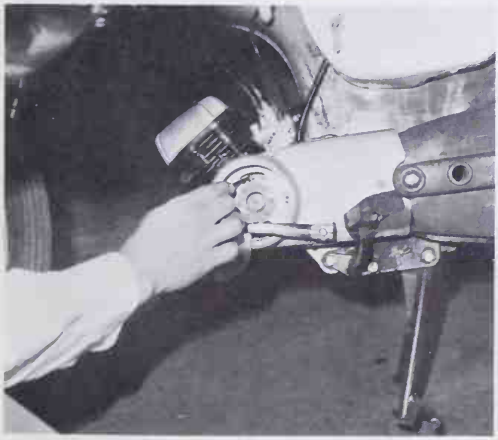
Tools in kit include spark plug wrench to be used with blade of Phillips screwdriver.



Scuzzy-looking plug like this is obvious clue to no-start or hard-start problem. Replacement is better than cleaning.



Check for spark at plug, grounding plug on head and working starter lever.



Breaker point location in typical AC magneto system makes it easy to check condition and gap.

average 50 cc two-stroke runs over 100 psi compression normally. If it is below 60, chances are it won't run. The 80 cc, 100 cc, and 125 cc models usually run from 115 to 125 psi normally. The 250s have about 140–150 psi. If this falls below 80 psi on the smaller bikes and 100 on the larger ones, they're in trouble, so let this be your guide. (It is difficult to find compression data on two-strokes in many of the factory service manuals, so experience and rule of thumb have to be the guide.)

⑩ To check compression, ordinarily the engine should be warm to get the most accurate reading. In the case of a non-start, however, it isn't critical. If lack of compression is the cause it will be quite low—50 per cent of normal or so. Proceed as follows: screw the compression gage end into the spark plug hole (or hold it firmly if using the automotive type), *open the throttle fully* and kick the starter over a couple of times.

Of course you can have compression at the top and none at the bottom in a two-stroke and it won't operate. So, if it appears to be normal in combustion pressure, suspect leaking sump seals or gaskets, other sump leakage, a sheared rotary valve pin, or that the fiber has sheared off the metal center.

If the engine fires occasionally but won't run this is a new set of conditions.

If it is a rotary valve model, the chances are the rotary valve disc is defective. The valve is fiber and subject to distortion from moisture as well as sheared drive. If the valve is bad (see illustrations of two-stroke principle) the mixture is either not drawn into the crankcase or compression is destroyed.

THE ENGINE IS HARD TO START—OR RUNS ERRATICALLY

The basic assumption here is that we are not just dealing with a tired engine, one which is crumbling into ruin or held together with wire and hope. If such is the case, it *should* be hard to start. Rather we assume that the bike is in normally good operating condition and that (1) it either becomes hard to start and runs erratically suddenly, or (2) the condition has been getting progressively worse for some time.

In either case, ① check the electrical system—paying particular attention to the battery if it is a part of the ignition system. All connections, it must be stressed, have to be clean and tight.

② Check the spark plug for type and condition. Perhaps the wrong heat range is being used, or another engine condition can be diagnosed by examining the plug.

③ Check the carburetor idle mixture screw. This often becomes maladjusted because the

owner doesn't watch what his hands are doing while gripping a screwdriver.

④ Check ignition timing and correct it if it is wrong. This cause of hard starting and erratic running is gradual in its onset, rather than sudden, because it is due to the wear of the cam fiber which causes a variation in point gap. So, if sudden hard starting is the case, a more likely suspect is the capacitor. Replace it if points are burned and discolored, which is a good sign of a faulty condenser.

⑤ This brings us to bad points: worn, dirty, pitted, or oily. Dress them or (preferably) replace them with a new set. If the breaker point area is oily, somewhere there is a bad oil seal in the drive. Replace it.

(On straight magneto models, inspect the pick-up and slip ring for dirt and grease and correct the condition if necessary.)

⑥ If the engine kicks back on starting, chances are the automatic advance mechanism in the distributor is not working properly.

⑦ Check the air filter. Remove and clean it. If it is ancient and excessively dirty, get a new one.

⑧ A clogged muffler can cause hard starting. If the bike is a high-mileage job, suspect this cause right away. If the diffuser is removable, clean it.

⑨ If the machine has been stored and has been put into use without proper attention to preparation, the carburetor idle jet can be clogged with varnish or oil residue. The main jet can likewise be plugged with this substance. Acetone is a good solvent, or regular carburetor cleaner such as that used in motorcycle shops can be used.

ENGINE DIES WHEN THROTTLE IS OPENED

Assuming that you are not being overly quick with the twist grip, this sort of death or slump of the engine can be attributed almost wholly to carburetion.

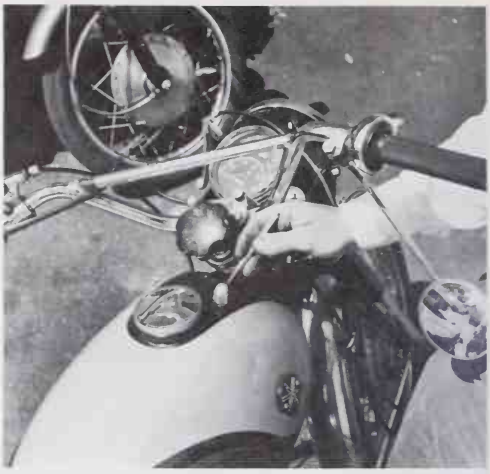
① Make sure that the choke lever is actually operating to open the choke fully when it is supposed to.

② Is the idling speed set high enough to accommodate a sudden increase in venturi area? If you have the engine ticking over at 200 RPM, it just can't induce enough pressure drop at the jet to suck up enough fuel.

③ How about the idle jet? Is it clogged?

④ The whole carburetion system can be too rich.

⑤ This isn't likely but it can happen: an air leak at the carburetor flange which has been compensated for by jetting, thus letting the engine



This vent, used on Yamaha and others, can get plugged.

Blowing through gas cap is test for venting ability.

This type of cap (neoprene liner) is almost totally immune to vent stoppage.

run, but reducing the vacuum. Squirt gas from an oil can around the attaching point and note whether the engine speeds up. This is a kind of last-resort suspect for this condition, but it is not uncommon in event of the following:

MISFIRES ON ACCELERATION

A: From low speed

If the engine is dropping shots under acceleration just off the line, but running satisfactorily otherwise, the odds are that carburetion is the villain.

① Examine the idle mixture. The classic symptom of too-rich low-speed mixture is misfiring on application of throttle. This is accompanied by a lumpy idle. Be sure the enriching for low speed is not overdone.

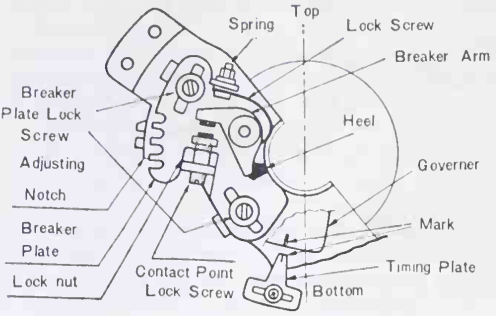
② Don't overlook the fact that there can be water in the carburetor float bowl which is sucked up at the start before the fuel can be replaced—or water in the mesh strainer and trap on some models.

③ A clogged air cleaner can cause misfiring, but it will generally also show up as poor performance throughout the range, too.

④ A bad spark plug, where the ceramic portion is dirty and causes flash-over, can also be responsible for this occurrence. Where high voltage is being fed into a system it chooses the easiest way to go and a dirty plug is an open invitation to a direct-to-ground short.

B: At a given RPM in any gear

If the misfiring occurs at a given RPM, no matter what gear you are using and no matter what the throttle opening, suspect the automatic spark advance mechanism in AC magneto systems. This can be going out of phase at a certain RPM. On battery systems the ignition may be out of time. Over-richness can also be causing "four-stroking."



Layout of contact breaker points (typical)—different units have different adjusting methods.

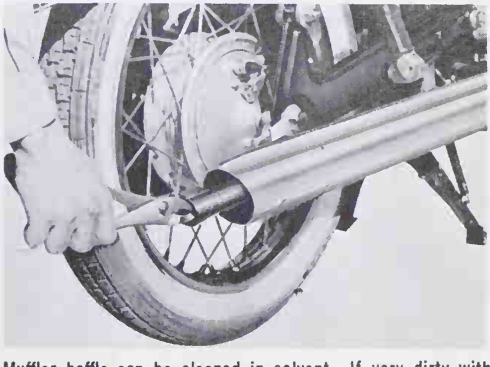
C: At a given throttle opening, regardless of RPM

If the dropping occurs at a certain point in the throttle sector regardless of the Rs being turned by the engine, this is poor carburetor tuning or a bad needle, perhaps one which is nicked or damaged.

D: At no consistent throttle opening or RPM

Inconsistent misfiring is ordinarily due to malfunctioning in the electrical system. Go over the bike from stem to stern sparing nothing from your rigorous scrutiny. Plugs, points, connections, high tension lead to the spark plug, capacitor, battery—the whole works can be individually or collectively responsible. The important point is to overlook nothing.

Idling mixture adjustment on typical two-stroke carburetor.



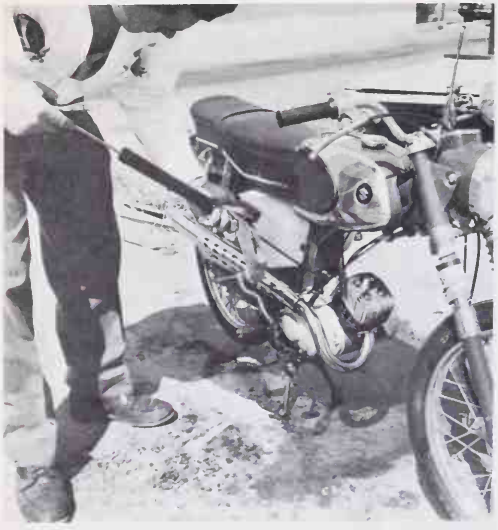
Muffler baffle can be cleaned in solvent. If very dirty with hard carbon it can be heated with a torch.

MISFIRES UNDER LOAD

This heading is meant to describe a condition something like this: You are riding along serenely and approach a hill. You open the throttle and as you mount the slope with the engine putting out its best efforts, it begins to drop a few beats. Gearing down, or returning to level road clears up the misfiring.

① First diagnosis of this condition is that the plug is breaking down from overheating. The wrong plug is being used or the gap is wrong.

A dirty carburetor such as this can always be suspected.



Cleaning dirty carburetor is a necessary step in locating fuel lack. Use solvent and plastic sprayer.

② Second choice would be, again, dirty air cleaner.

③ Too large a main jet, with insufficient pressure drop at wide throttle opening and relatively low speed, results in improper mixture. Tuning is indicated.

④ Poor fuel can play a big role in this sort of performance. Premium fuel, as recommended by

KLG assembled type spark plug can be used to check ignition system output without fear of shock.

Take KLG assembled type plug apart and use inner core to check condition of spark output. Holding electrode near engine and operating starter should produce good spark.

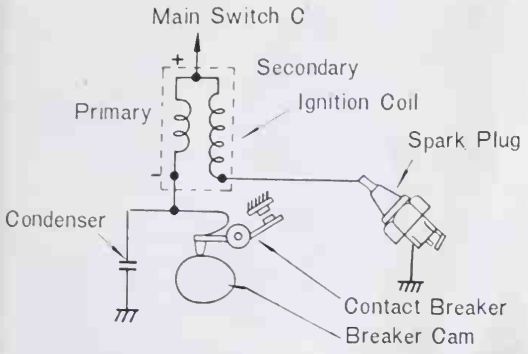


Diagram of ignition system using coil.

the manufacturer, should be used at all times. "Cheap" gas is poor economy.

⑤ Improper timing would be about the fifth item in line to be considered. Spark timing becomes more critical as the load increases.

⑥ Finally, and not to be overlooked: Is the gear being used too high for the conditions encountered?

MISFIRES AT HIGH SPEED

① Since the main jet, without being influenced much by the needle, is responsible for mixture control at high speed, it should be looked into first off. Follow the specifications in fitting this important component . . . or adjust according to tuning information supplied in other parts of this book.

② Believe it or not, that old dirty air cleaner crops up again in this situation. Check it.

③ Improper float level is a common cause of high speed misfire. Set too low, the float does not permit sufficient fuel to accumulate in the bowl to serve the needs of the carburetor.

④ Spark plug: dirty, wrong heat range, improper gap, faulty. Any or all of these plug faults can be responsible. High pressure breakdown of a seemingly good plug can also be the trouble. Heat range is pretty critical in air cooled engines. If the plug is too cold it shorts out, if too hot it welds. If the gap is too great the cylinder pressure prevents the arc from forming across the expanse between the electrodes.

⑤ Bad capacitor. Especially on the AC magneto system, a poor capacitor can perform satisfactorily at low speeds yet fail to prevent point arcing at higher Rs. Have it checked or substitute a new one if everything else is right.

⑥ Coil. Same situation as with capacitor.

⑦ High tension leads leaking. Be sure the plug wire is not leaning on metal which would invite a direct ground. Rev the engine up and run your fingers along the plug wire. You'll feel a tingle if there is leakage.

⑧ Air leak at the carburetor flange is another possibility. Follow clues under ⑤ in ENGINE DIES WHEN THROTTLE IS OPENED.

⑨ Leaking head gasket.

⑩ Leaking cylinder/crankcase gasket.

⑪ Bad crankshaft oil seal.

These three can cause too-lean a mixture and thus be responsible for misfiring. Try the same tactics as described to check for a leak at the carburetor flange. Often a new dressing of gasket compound will take care of the problem.

⑫ Don't overlook the clogged muffler reminder. This condition breeds all sorts of symptoms.

POOR LOW SPEED PERFORMANCE

This symptom is presumed to be apparent as stumbling or lack of power at low Rs which clears out in the upper range of the engine. This is not to be mistaken, of course, for the loading-up which occurs at prolonged idle and which disappears as soon as excess fuel and carbon are blown out, but rather a consistent lack of performance in the bottom half of the power curve.

① Number one trouble-causer in this situation is improper carburetion: wrong idle adjustment, wrong needle setting, etc. Tuning is the answer.

② Second, and not too far behind in frequency, is improper spark advance. Between these two, you'll probably find the trouble.

POOR HIGH SPEED PERFORMANCE

Complaints here are a lack of power at what should be the peak torque of the engine, reduced top speed and the need to shift down more frequently. Actually, in most cases, the rider just doesn't notice it but there is a general lack of power throughout the range of the engine. It is only that it becomes most noticeable when more is asked of the engine. However, if it is clearly only the top end:

① Again, wrong carburetion adjustment is the prime suspect.

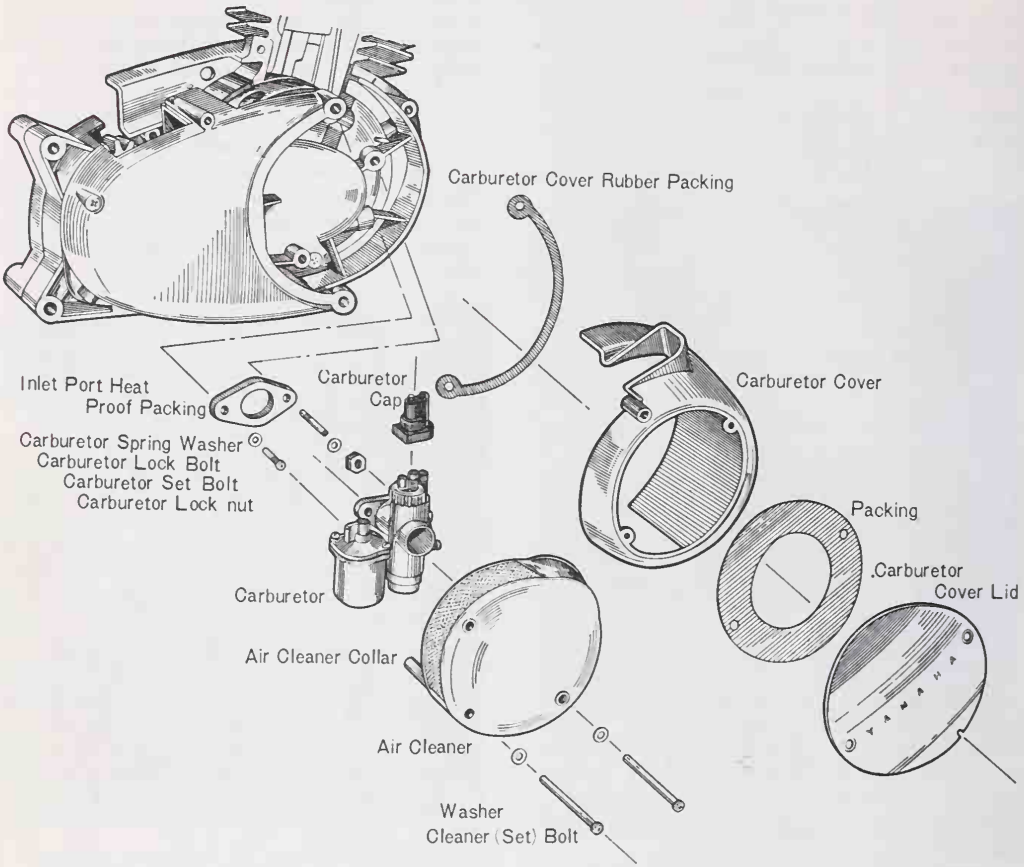
② Dirty, clogged or bad air cleaner. This condition can be borderline, permitting enough air flow to take care of low speed operation but causing an over-rich condition at full demand.

③ Ignition timing and cleanliness of ignition system play a big part in top-end performance.

④ Spark plug and wiring.

See MISFIRES AT HIGH SPEED (above) for more details. The engine can drop off in power yet apparently be hitting on every stroke.

⑤ Battery condition is important in certain



electrical circuits. Have it checked for output and ability to complete the circuit.

⑥ Poor mechanical condition: bad rings, low compression, leaking gaskets and seals, clogged ports. Borderline components reveal themselves first at top speed.

⑦ Is the rider too heavy for the machine? Surprisingly enough, some owner complaints stem from the simple fact that the horsepower isn't enough for the job and there's nothing wrong with the bike at all.

⑧ Check the tire pressures. Low tires cause increased rolling resistance but a large number of riders fail to take this into consideration.

⑨ Check for slipping clutch. See CLUTCH AND TRANSMISSION section.

⑩ Possible cause could be plugged fuel tank vent or restricted gas lines.

POOR GENERAL PERFORMANCE

Under this heading, naturally, can be lumped any single cause or combination of causes conceivably connected with the engine . . . and for that matter other portions of the bike. But let's run through the most common causes, in order of their frequency.

① First suspicion should fall on the ignition timing. If it is off the engine is just hopeless in performance.

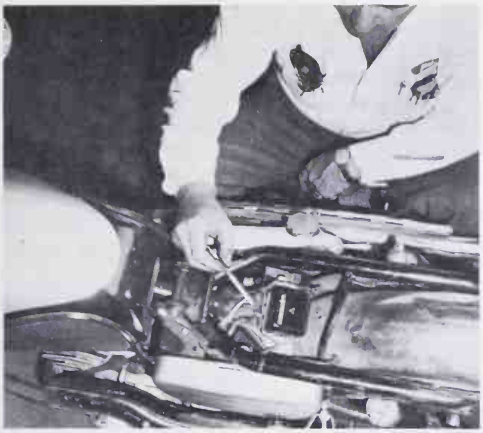
② Spark plug. Improper type, fouled, dirty, etc.

③ Poor carburetion. Symptoms of over-richness or too lean a mixture are easy to detect by examination of plug and exhaust pipe. See TUNING for clues.

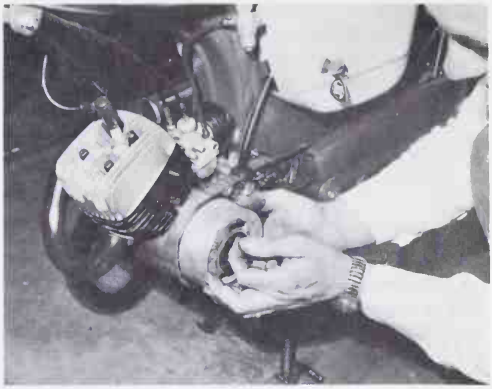
④ Is the bike running free? Check the rear wheel as the machine sits on the stand. Does it turn over easily? Is the brake dragging? Are wheel bearings bad? Is the chain too tight? Any of these items can slow the bike so much that the tendency is to suspect a poor-performing engine.

⑤ Slipping clutch. This should be an obvious condition to even a novice rider, but a surprising number of people don't notice it.

⑥ Poor general condition. Under this heading

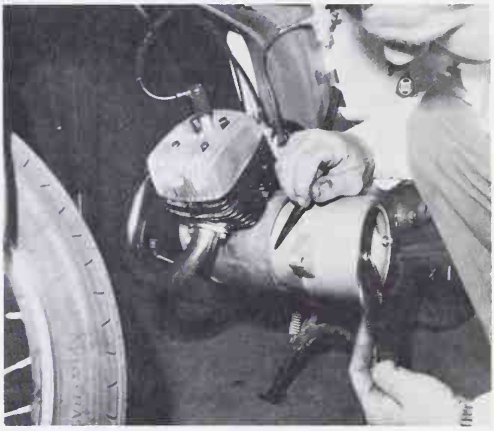


Voltage regulator and connections are under seat of Yamaha Big Bear and other models.

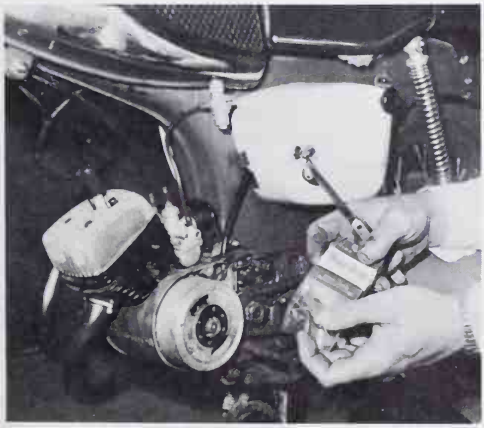


Put cellophane strip between closed points, tug gently and rotate flywheel to timing marks. Points should just open and release paper when marks coincide.

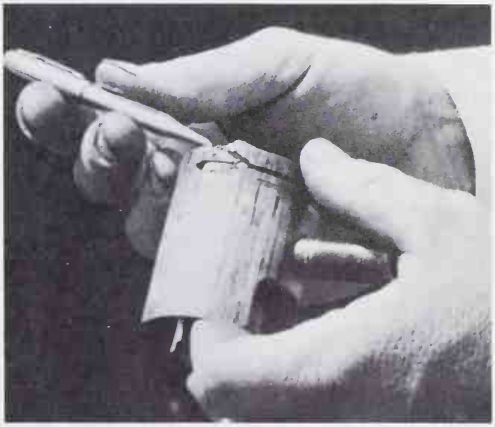
It is necessary to remove gear change lever on some models to take off transmission side cover.



Location of timing marks on Suzuki 80, typical of flywheel rotor AC magneto systems.



Use a strip of cellophane from cigarette package in emergency for checking timing.



Burned piston shows evidence of vaporizing at exhaust port. Lack of oil, too-lean fuel mixture, wrong spark advance can produce this condition.

we find the low-compression causes: worn piston rings, bad seals at crankcase (cylinder-to-case, end seals of crankshaft), etc. And on the high-mileage model this should be obvious after a routine check-up. On a newer cycle, damage to gaskets, faulty seals or non-seated rings can be the problem.

OVERHEATING AND SEIZING

The air-cooled engine is a marvel of efficiency but it is only human. In the motorcycle installation, without any cooling fan, the engine depends on a stream of air caused by the vehicle's motion to carry away the heat generated by combustion and friction. Overloading or riding too slowly will result in a build-up of heat which, in turn, leads to piston seizure and difficulties of that nature. However, overheating under normal conditions (that is, under similar circumstances which previously did not cause overheating) is a fairly common complaint.

Most small two-strokers, of the trail variety particularly, experience piston seizure at some time in their career without any real damage. Just letting the machine cool down and free itself is generally sufficient, but if the engine does not perform up to standard after such an experience, broken rings and scored cylinder walls are probably to blame.

If the bike is prone to overheat, any one of several causes could be present.

① Incorrect fuel/oil mixture. Insufficient oil in the mixture or the wrong grade of oil can cause overheating. If the tank is accidentally filled with straight gas and the engine operated it will seize in a short time.

② Lack of oil in the automatic oiler tank or inoperative oil metering device. (See section at the end of this chapter on these devices.)

③ Fuel-air ratio wrong. Too lean a mixture is a prime cause of overheating. Set carburetor adjustment to provide richer mixture.

④ Retarded ignition. Failure of automatic advance mechanism or incorrect static timing can be responsible.

⑤ Entrance of air into combustion mixture. Here is the leaky gasket or oil seal bit again. Carburetor, head, cylinder/sump or crankshaft end sealing is poor. Squirting gasoline from an oil can at the junctions with the engine running is a crude test. If the engine speeds up, you've found the bad gasket without much effort.

⑥ Wrong heat range spark plug. Overheating is usually just one of the symptoms when the wrong plug is used. It helps confirm the cause of misfiring and loss of power.

⑦ Excess carbon deposits in combustion chamber. Take a compression check. If it is grossly high but the cycle doesn't run particularly well, and especially if it has a tendency to "run on" after the ignition, there is a carbon build-up which must be removed to restore performance.

⑧ This is somewhat rare, but if you don't know the history of the offending engine, it is possible that somebody installed the wrong head gasket and compression is too high. Or, the head could have been milled or the case stuffed to increase compression and performance with a consequent heat build-up the engine's fins weren't designed to cope with.

⑨ Clogged exhaust port. Accompanies excess carbon in combustion chamber.

⑩ Clogged exhaust pipe. Too much back pressure can cause overheating. Clean the system.

⑪ Slipping clutch. This is, again, rare and seemingly impossible to overlook, but it has been known to be the basis of an owner's complaint.

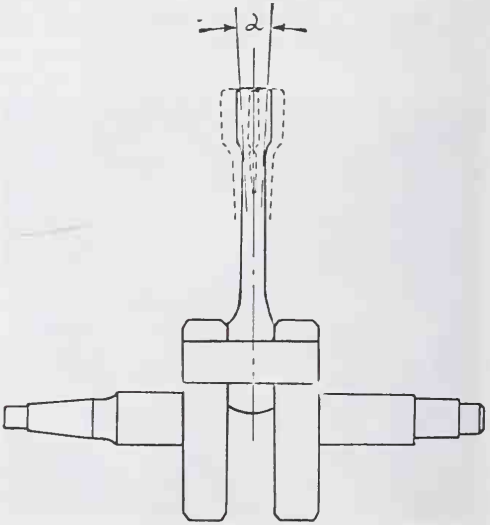
⑫ Chassis faults: brake dragging, bad wheel bearings, low tires, etc. all combine to place a drag on the engine.

⑬ Overloading. This comes under the same general category as improper use.

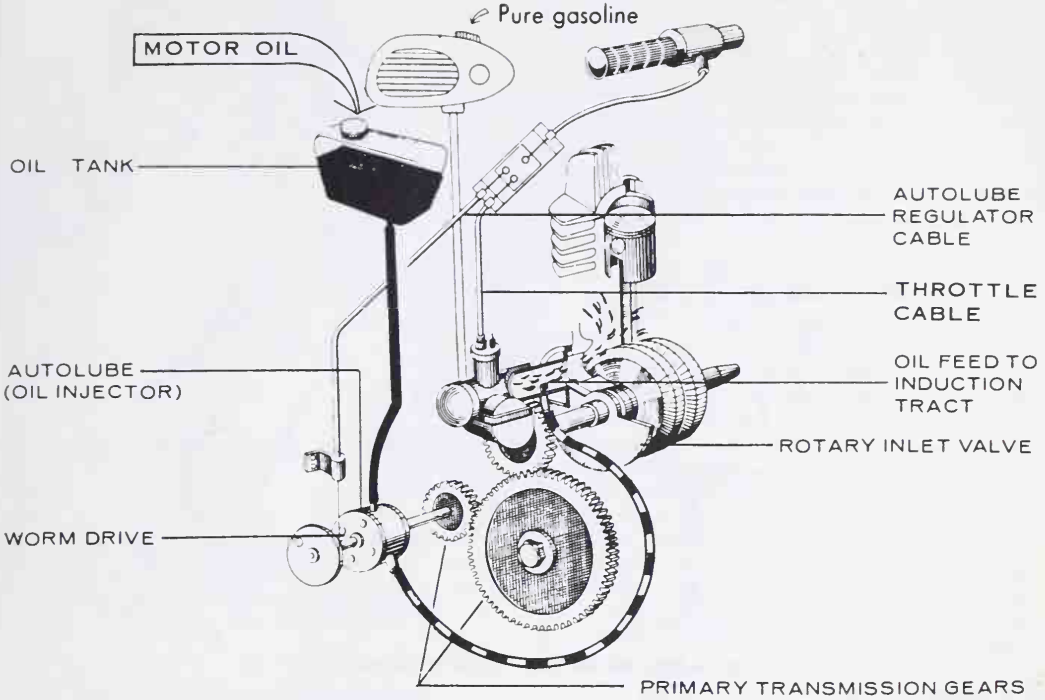
⑭ Dirty engine. The cooling fins can't dissipate much heat if they are covered with mud, dirt or grime. Not that they have to be spotless, but an excess of detritus can cause overheating.

VIBRATION

Excess vibration is usually directly traceable to loose, broken or worn motor mounts and all mounting points should be inspected *carefully*.



Connecting rod end-shake caused by worn big end bearings causes piston slap.



Yamaha Autolube oil injection system in schematic form.

The emphasis on the last word is because a mount plate can be fractured *under* a bolt head and thus be concealed.

Incorrect clutch assembly, poor timing, worn crankshaft are other possibilities, but they are fairly easy to trace since the onset would either be gradual (in the case of the crank) or following some tinkering. If the bike is new to you, a thorough inspection of all these possible causes should be carried out since vibration is usually a prelude to some sort of failure.

NOISES

Two-stroke noises are different from anything else and in the case of the air-cooled engine they are even more distinct in character. Any abnormal noises are cause for investigation although they may be only the result of normal wear causing greater clearances, etc. Unusual noises can be classified in three ways: intermittent, continuous and changing according to conditions.

Intermittent noises (not always present):

① ***On hard acceleration, a click or clatter*** can be the result of a build-up of carbon deposits on the rings which destroys end clearance, or it can be excessive ring land clearance. A *heavier sound,* but still a light mechanical sound and sometimes a double-rap is generally worn piston pins or bushings. A *knock* under these circumstances is ordinarily traceable to connecting rod bearings. *Pinging* is caused by low-test fuel, carbon build-up in combustion chamber or too much spark advance.

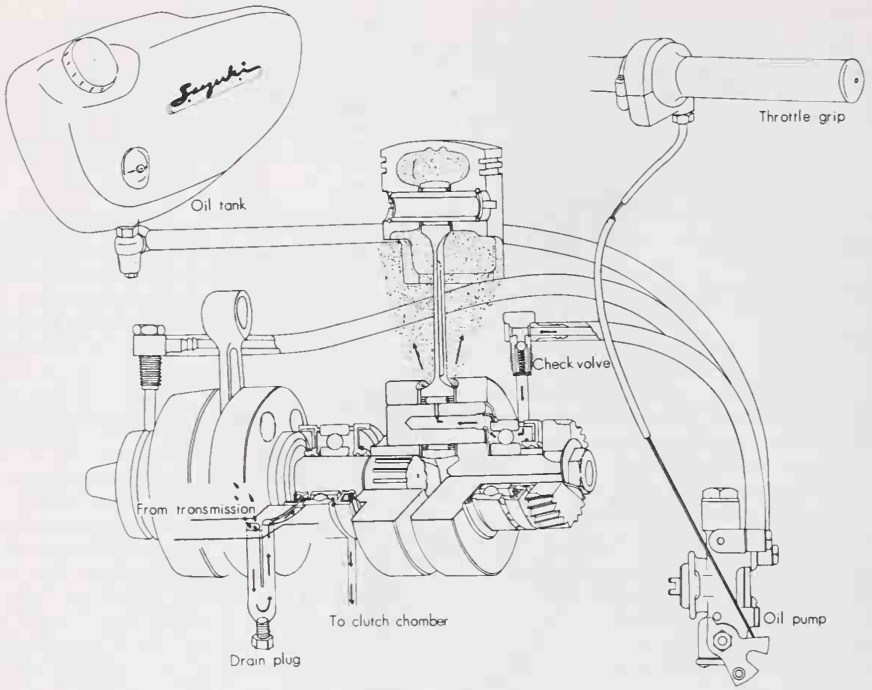
② ***At low RPM a rattle or clank*** is indicative of piston slap, or excessive clearance between piston and cylinder wall. A *lighter noise* but strictly metallic can be the piston impinging on port openings. Check this by closing the throttle quickly and noting if the cylinder head vibrates.

Changing noises

Noises which change according to conditions ordinarily come and go because of temperature changes. These are metallic light knocks.

① ***On starting engine or when cold*** indicates excessive piston/cylinder clearance if it vanished when the engine is hot.

② ***At high temperature*** if the same sound as when cold but diminished somewhat, this is a sure sign of too much clearance. If the sound occurs more when hot than when cold, it can be a bent connecting rod.



Suzuki Posi-Force lubrication system in schematic form.

Continuous noises

① ***A heavy thump*** under all conditions generally stands for bad crank bearings. However, it can be a flywheel rubbing against the case because of improper shimming, causing the crank to be off center.

② ***Sharp knock*** is descriptive of piston rings catching on the lip of a port.

③ ***Clutch noises*** are often credited to the engine. Excess clearance between clutch steel plates and the hub is a fooler. The noise here decreases or quits entirely when the clutch is disengaged.

THE OILERS

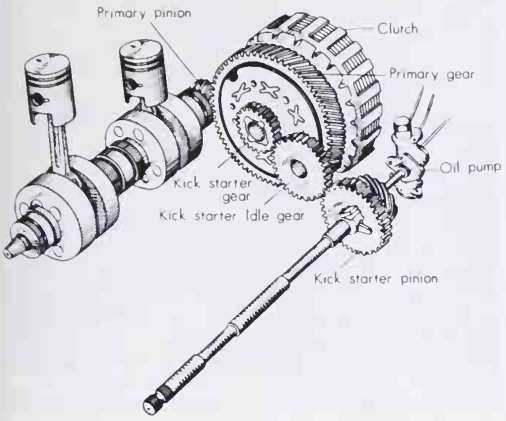
As far as convenience and efficiency are concerned, the introduction of automatic oiling systems was a dramatic improvement in two-stroke motorcycles. However, these pumps and their attendant plumbing give the rider one more item to learn about and consider. The rate of failure and faulty operation has been no greater than any other oil pump system in any four-stroke motorcycle, but since many dealers and owners had never worried about such a device on a two-stroke before, there have been some loud complaints when things went wrong.

Two systems are used. One is exemplified by the Yamaha "Autolube." Oil is injected into the fuel-air mixture behind the carburetor venturi and lubrication is accomplished in the same manner as in the conventional gas/oil pre-mix method. The difference is that the amount of lubricant is metered according to engine speed and load with a rich mixture of oil for high speed and a lesser amount of oil for idling, etc. In addition the system provides for lubrication with the throttle completely closed where the engine is being used as a brake on long downhill runs.

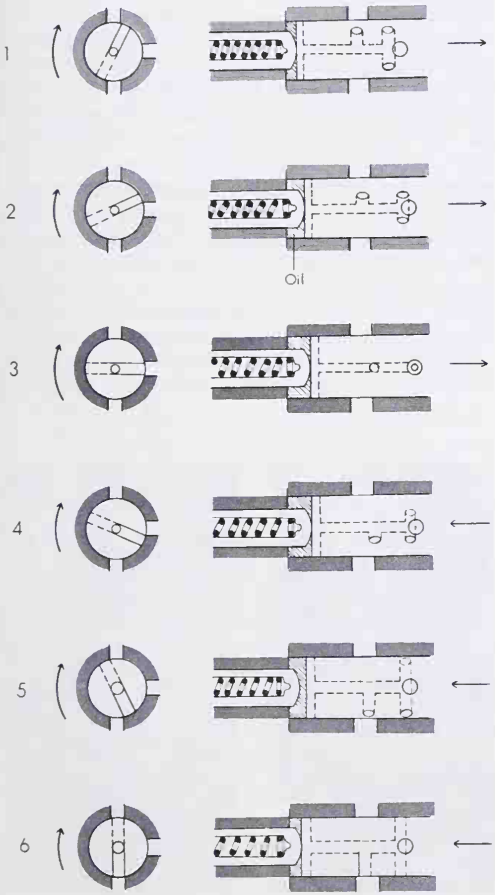
The second system is typified by Suzuki's "Posi-Force" method where oil is pressure-fed to the crankshaft and via drilled passages to the connecting rod and then sprayed into the fuel-air mixture in the cylinder. The amount of lubricant delivered is controlled by throttle position and engine needs.

Accompanying illustrations will make the parts relationship clear.

In the Yamaha 250 and 305 the pump is driven off the main gear (primary) and is thus operated only when the clutch is engaged. In the Suzuki, the pump takes off from a gear on the starter shaft and is in action regardless of whether the clutch is engaged or not. The only operating hazard of the Yamaha system in the 250 and 305 is that of running the engine for long periods with the clutch lever held down. This is a bad habit of some riders who wait out traffic signals with first gear engaged and the clutch thrown out.



Suzuki pump is driven off kick starter gearing.



Plunger rotation controls delivery timing in Suzuki pump.

Oil delivery failure symptoms are overheating and piston seizure. You can make a quick check by disconnecting the delivery hose on the Autolube type and running the engine at various throttle openings. The Suzuki pump is behind a cover at the right rear of the crankcase and it has transparent tubing, so oil flow can be observed with the engine running.

In case of failure (except Suzuki) you can mix oil with the fuel in the conventional two-stroke fashion and operate the cycle long enough to get it repaired.

OIL PUMP OPERATION

Suzuki

The Suzuki pump is a rotating plunger type where the rotation of the drive worm and the plunger body is turned into reciprocating motion by a machined ramp on the end of the plunger engaging a plunger guide. The length of the plunger stroke is controlled by a cam which changes position according to throttle opening. The cam holds the plunger away from the guide and limits the engagement of the machined ramp when throttle is closed or allows it to touch all of the ramp fully when open. The rotation of the plunger covers and uncovers inlet and discharge ports as follows:

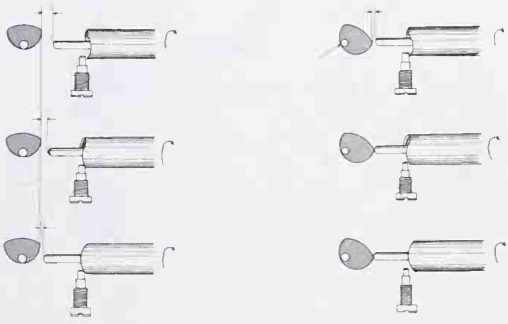
① Oil discharging finishes and the plunger begins moving downward while rotating. Plunger operation enters the oil intake stage.

② The plunger moves down more and a vacuum is created in the oil pump cylinder above the plunger.

③ The plunger nears bottom dead center and one of the two plunger intake ports aligns with the cylinder intake port. Oil is sucked into the cylinder by induction created above the plunger.

④ Oil intake is finished and the plunger begins to move upward while rotating. Oil in the cylinder begins to be compressed.

⑤ The plunger moves up more and the oil is further compressed. The oil pressure causes the differential plunger to be pushed up and move



away from the plunger. In this procedure, the oil in the cylinder is compressed by the differential plunger and oil is discharged smoothly.

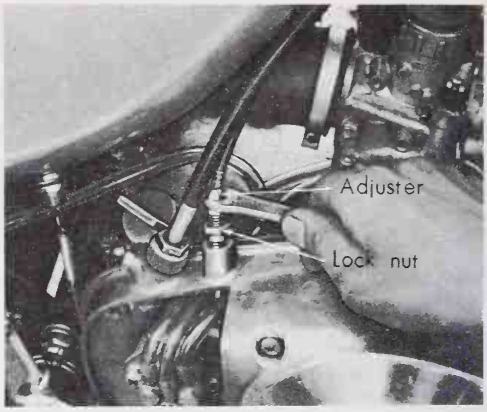
⑥ When the plunger nears the top dead center position the plunger discharge port aligns with one cylinder discharge port. The compressed oil is discharged.

When the pump driving worm is driven by the kick starter pinion, the plunger, engaged at a 90° angle with the worm, rotates. A circular ramp is machined into the bottom of the plunger. This ramp section engages the plunger guide screw and the plunger moves up and down by utilizing the plunger rotating action.

The combination of rotating action and up and down movement opens and closes the intake port and discharge ports, changes displacement in the oil pump cylinder and changes the pressure of the oil. The oil is supplied separately to right and left crankshaft bearings through two oil discharge ports. The oil pump control cable, which is synchronized with the throttle cable, is fitted to the oil pump control lever. The control lever is pulled in accordance with the throttle opening and turns a cam fitted to the lever. When the throttle is opened only slightly, the cam limits the length of the oil pump plunger stroke. When the throttle opening is increased, the cam turns and allows a longer plunger stroke, so that the amount of oil discharged increases.

Check valves are located in the bolts which hold the oil lines and the crankcase bearings to the case. (See illustration.) They should be clean and filled with oil when removed and replaced. Fill the holes in the crankcase with about 10 cc of oil to make sure.

Note: Be sure the gaskets on the banjo bolts are installed correctly. The grooved side of the gasket should be against the fitting. (See illustration.)



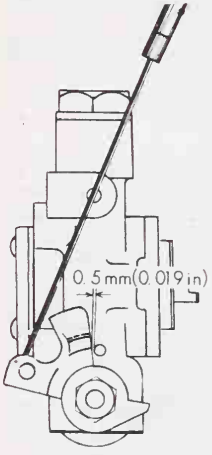
Adjustment of oil pump control cable on Suzuki (typical).

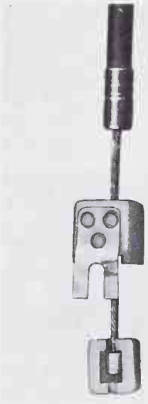
Correct tightening torques: check valve—35 inch-pounds; banjo bolts—21 inch-pounds.

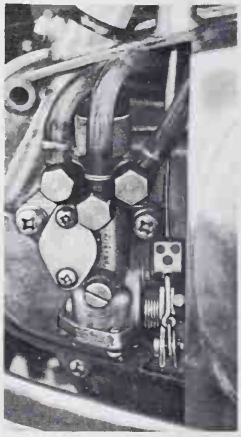
Yamaha

Yamaha's pump is driven through reduction gears by the primary gear on the engine's crankshaft. Rotary motion of the plunger is turned into reciprocal motion by an eccentric and guide pin and the distributor plate on the end of the shaft alternately covers and uncovers inlet and outlet holes. Length of the plunger stroke is controlled according to throttle opening by a cam which moves the adjusting pulley in or out to limit or increase plunger stroke. Clearance between "Adjust Plate" and the boss of the "Adjust Pulley" in the illustration determines pump stroke. The pulley is rotated by a wire to the throttle.

A check valve prevents oil from seeping out of the pump case when it is not operating.







Oil pump problems (both types)

① Improper adjustment of control cable or broken cable

② Air lock of pump (or bubbles)

③ Pump failure

Suzuki Posi-Force adjustment procedure

① Open the throttle fully and make sure there is no play in the cable. (Check both cables on twins and synchronize throttles if necessary.)

② Remove pump cover and observe the clearance between the control lever and the pin. This should be .5 mm (.019"–.020"). It is better to be on the tight side; if the gap is larger, less oil is delivered.

③ Adjust as necessary (at the point shown in the illustration) with throttle wide open.

Yamaha Autolube adjustment procedure

Two adjustment procedures are used for Yamaha type pumps. With all two cylinder engines the adjustment of the operating cable is made at closed throttle position; all singles are adjusted at half-throttle. On later models there is a small circle marked on the throttle valve to show half-open position. On earlier models it is necessary to measure the throttle travel and gage the halfway position.

Measurement of the pump stroke is made (as shown in the illustration) between the boss on the adjust pulley and the adjust plate with a minimum clearance of .24 mm to .30 mm (.09" to .12") as mandatory.

Twin cylinder engines

① Synchronize throttles and adjust the throttle cable at the grip for the necessary free-play. Leave throttle closed.

② Match adjust pulley guide pin and V mark on pulley by first loosening the lock nut, then screwing the adjusting nut on the pump control cable.

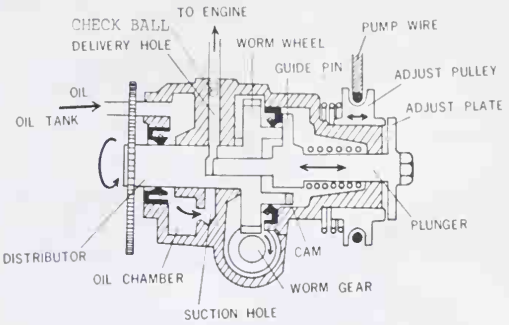
Single cylinder engines

① Block the carburetor throttle half open.

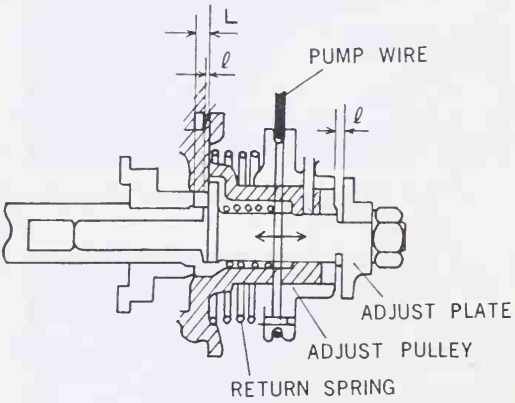
② Match the V mark on the pulley with the guide pin by adjusting the pump control cable at the sleeve nut on the cable.

If this adjustment results in less than .24 mm or more than .30 mm clearance between the pulley and the plate, it is necessary to change the shim behind the plate. This is extremely rare and represents an assembly error, rather than wear.

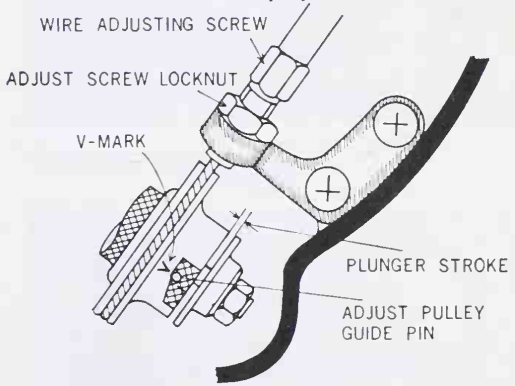
An air lock in the pump ordinarily occurs only in the case of a replacement pump being not properly primed. Bubbles and poor delivery occur when air enters the line from a leaky joint. Squirting oil on suspected joints or smearing them with grease will show up leaks which occur in apparently tight unions.



Cutaway of Suzuki pump.



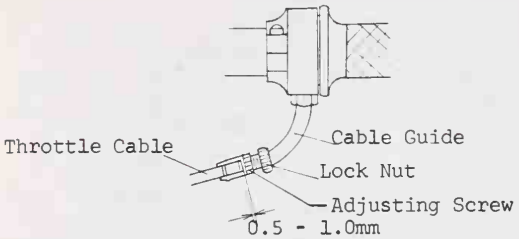
Minimum clearance at Q is .24-.30 mm (.09-.12") for Yamaha pump.



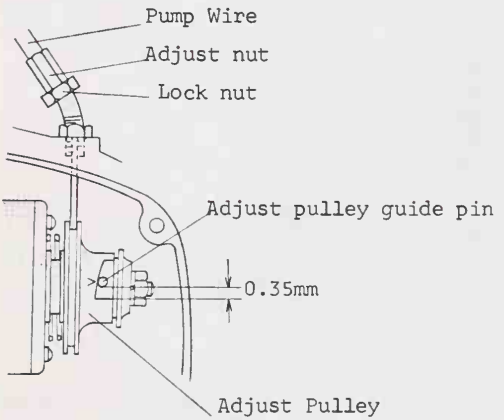
Adjustment of pump on Yamaha singles (typical).

Complete pump failure is comparatively rare but in the Yamaha pump, the adjust pulley guide pin has been known to fall out, so if the pump obviously quits, this is a first place to look.

Refer to the following condensed troubleshooting guide for further details on Yamaha pump problems.



Correct adjustment of throttle cable on Yamaha twins.



Adjustment of pump stroke on Yamaha twins (typical).

Yamaha pump troubleshooting

Trouble

① Poor oil delivery

Cause

a. Bubbles in oil in the pump case

Remedy

a. Bleed the pump
b. Check the following points for oil leaking:
(1) Breather gasket
(2) Suction pipe connector and pump case
(3) Distributor oil seal
(4) Distributor plug
(5) Pump case
(6) Banjo and pump case
(7) Pump and crankcase cover
(8) Pump case cover and pump case
(9) Terminal of plunger; plunger cover, plunger cam oil seal and plunger oil seal

Trouble

② Pump fails to work. (Engine works.)

Cause

a. Defective worm wheel pin
b. Clogged pin hole
Worn pin hole
Deformed return spring

Remedy

a. Clean pin hole
b. Replace spring

Trouble

③ Plunger does not work. (Distributor or starter plate rotates.)

Cause

a. Worn or clogged guide groove for plunger cam guide pin
b. Adjust-pulley guide pin missing

Remedy

a. Replace pump case cover
b. Replace pump correctly

Trouble

④ Distributor hard to rotate

Cause

a. Incorrect adjustment of worm wheel plate
b. Incorrect fitting of plunger cam oil seal

Remedy

a. Proper clearance is 0.05 to 0.1 mm
b. Replace or refit

Trouble

⑤ Distributor partly hard to rotate

Cause

a. Worn or clogged guide groove for plunger cam guide pin

Remedy

a. Replace pump case cover

Trouble

⑥ Adjust-pulley fails to move in contact with cam surface

Cause

a. Incorrect fitting of adjustment components
b. Too tight fitting between adjust pulley and pump case cover

Remedy

a. Refit
b. Replace

Trouble

⑦ Incorrect pump setting

Cause

a. Defective cam of adjust pulley
b. Defective plunger cam
c. Wrong fitting of control cable to adjust pulley
d. Too big clearance between adjust pulley and pump case cover
e. Too much play in cable

Remedy

a. Replace
b. Replace
c. Refit
d. Replace
e. Readjust

Chapter 3

Electrical Systems

There are several electrical systems found on motorcycles today. One or two may be familiar to the average rider because of automobile experience, others have ramifications which are less well known.

The first and oldest is the magneto for ignition and dry cells for lights. This is pretty rare but some models from a bygone era still use it.

Most bikes with magneto ignition have a DC generator or an alternator for lighting. This is typical of many BSA, Triumph and other British bikes with Lucas electricals.

The second oldest system, used by a great number of motorcycles, is exactly like that of the automobile with generator-battery-coil systems using direct current. Yamaha, Suzuki and Kawasaki 125-250cc models are probably the most familiar examples.

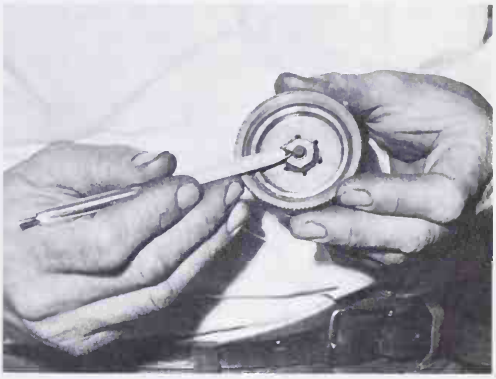
The alternator has been adopted by motorcycle manufacturers because of its reliability and versatility. In the AC system, there are several variations on a basic idea. One is to use the alternator as a magneto for ignition and put a rectifier in the circuit to convert its output to DC for lighting. A second is to utilize the alternator for both ignition and lighting, employing AC for everything. A third is to use the alternator to supply ignition and headlights but have a battery to feed neutral indicator light, horn and stop light regardless of whether the motor is running. A variation of this is to use DC for ignition in addition to stop light, indicator and horn.

Generally speaking, the smallest displacement models in the two-stroke bikes have the simplest system: alternator or AC magneto supplying output directly to the ignition, with other coils of the alternator devoted to (a) headlights and tail lights and (b) charging the battery. Several BSA models also use this system.

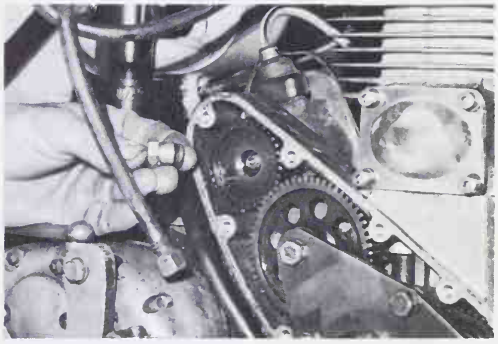
Magneto

The "conventional" magneto is gear driven and puts out a whopping good spark, increasing intensity with RPM, and is relatively free from malfunctions, which has caused it to be used on high-performance machines rather widely.

Two types are in use: fixed advance and automatic advance. The former will be found mostly on racing bikes, and both types are largely Lucas-built as far as cycles in this country are concerned. A "Magdyno" made by Lucas, which incorporates a generator in an attaching case is found on many older British singles. The operation of the magneto is the same as if it was



Disintegrated kill-button carbon contact on magneto can cause internal short.



Fixed-advance magneto uses tapered shaft and nut which requires special puller.

Checking ignition timing of magneto with static timing light/buzzer.

alone and the generator likewise.

The most common problem encountered with the magneto is poor performance caused by dirty, oily high-tension pick up and slip ring. Crankcase vapors seep into the case and deposit oil, which collects other grime. Replace the oil seal.

Remove the pick ups and wipe clean. Make sure that the brush projects out of the case at least ¼" and works freely. Clean the slip ring by holding a clean cloth against it and turning the engine over.

The breaker points on mags are possibly not as critical as other ignition systems, but must be kept fresh, making good contact, properly gapped and carefully aligned at all times.

Broken wires or internal shorts are rare on magnetos, but the leads from the pick ups can fray or short out. The symptoms are complete lack of delivery. Before going into the end of the case, check to be sure that the kill-button wire is not grounding.

An infrequent occurrence, but one which has been known to follow an unskilled overhaul, is the destruction of the carbon contact for the kill button. Improperly installed, it can be disintegrated and short out the magneto.

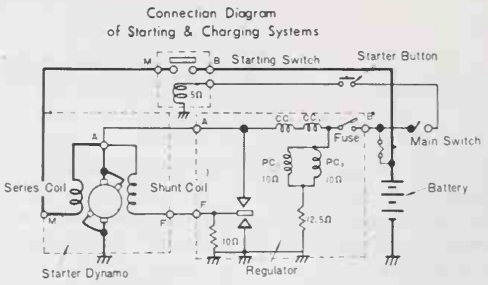
Even in making a quick check on a non-delivering magneto, it is a good idea to put the bike on the stand and rotate the rear wheel with gearbox in top gear. With the breaker point cover plate off, you can determine right away if the armature gear is slipping on the shaft, for example.

The fixed-advance magnetos utilize a tapered shaft and the gear must be tapped on and pulled off with a puller. If once secured, they seldom work off, but it can happen. The automatic advance type has a self pulling nut to draw the gear onto the taper and it also withdraws. So, loose gear on shaft can be a problem. Ordinarily, this doesn't just happen and cause non-delivery of spark, but results in out-of-time firing first.

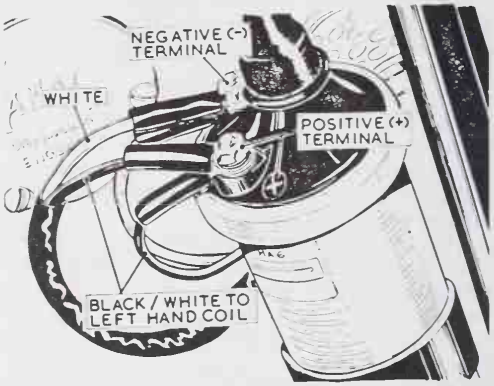
To test the armature coil and condenser, remove it from the housing and connect a wire from one terminal of a two-volt dry cell to the center screw of the breaker plate. Connect one side of an ammeter to the other battery terminal and the other side to the armature. Continuity should be proven and a reading of 4 amps indicates normal resistance.

Using the same battery as a power source in the same way, make and break the contact at the center screw several times with an assistant holding one end of a short length of plug wire grounded against the armature body and the other about ⅛" away from the slip ring contact. If the high tension side is good it will build up the voltage enough to make a good spark at the gap.

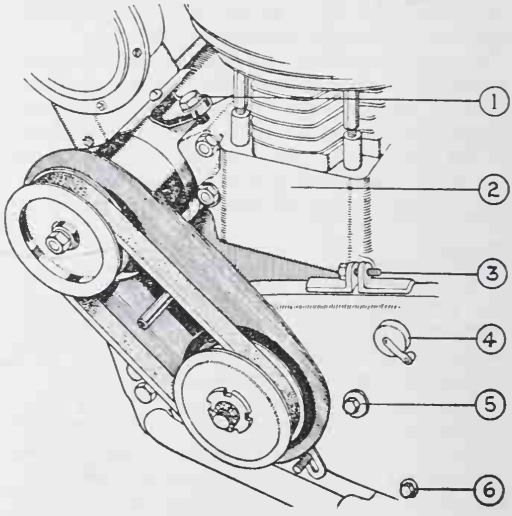
Worn cam rings can cause such a divergence in timing on twins that the magneto is blamed.



Wiring diagram for starter-generator.



Polarity of British bikes since 1951 has been positive ground; prior model years and all Japanese cycles have negative ground.



Velocette generator is driven by belt. To adjust, loosen clamp bolt (1) and turn generator in its mount. Deflection of belt should be approximately ¼".

Item	Trouble	Causes	Results	Action
Positive Plates	Plate Moteriol Drops to Bottom of Cose	·Excessive charging and discharging. ·Excessive charging current. ·Solution specific gravity too high.	·Capacity decreases considerably. ·Sediment causes short circuit at bottom of cell.	·No way to repair. Replace battery. ·Find trouble and correct at early stage.
	Warpage	·Over-discharging. ·Charging and discharging with large current. ·Battery used at high temperatures.	·Capacity decreases. ·Short circuit.	·No way to repair. Replace battery.
Negative Plates	Sulphation	·Battery left in discharged canditian. ·Battery used without enough charge. ·Exposed plates. ·Salutian too thick. ·Foreign particles in salutian.	·White dots seen on plates. ·Specific gravity drops and capacity decreases. ·Voltage rises and bubbles seen when charging but will not take charge.	·If sulphatian is slight battery can be charged with very small current for long time. ·If sulphatian is great, replace battery.
	Shrinkage	·Repeated high rate of discharging. ·Repeated over-charging.	·Battery can be charged but capacity decreases rapidly. ·Voltage at finish of discharging high.	·Replace battery.
Separator	Carbonizing	·High temperatures. ·High salutian specific gravity. ·Warped plates.	·Separators become brittle.	·Replace battery.

Battery problems, causes and remedies.

Check timing closely and if there is more than 1/16" variation in piston movement to affect point opening, replace the ring.

Excess bearing wear and consequent armature vibration can be mistaken for other engine mechanical noises. The condition should be attended to inasmuch as damage to the shaft results. If there is more than .005" vertical play at the end of the shaft, replace the bearings.

DC generator system

The DC generator-based electrical system is analogous to that of the automobile in some machines, slightly different in others. Japanese bikes of the medium displacement variety, such as Yamaha, Suzuki and Kawasaki 125–250cc models, have a complete DC system with a starter-dynamo, voltage regulator, coil, condenser, etc. Newer British cycles generally have dynamos or starter-dynamos and magneto ignition when DC is used. Japanese systems are negative ground, British models built since 1951 have been positive ground. Prior to that they were also negative ground. Harley-Davidsons have negative ground also.

This pretty well divides up the troubleshooting into two categories: (a) full system, and (b) lighting only.

Let's dispose of the systems which use a DC generator (or dynamo if you speak British) only for lighting or perhaps a starter-dynamo for starting and lights.

Troubles here generally revolve around no lights, no horn, no start caused by a flat battery or bad connections.

In any case, suspect the battery first since it is responsible 90% of the time.

The first place to check is at the battery terminals. If they are slightly loose, corrosion occurs between the terminal and the cables and so much resistance is put into the circuit that current can't flow. It takes a *clean*, firm contact, so make sure all connections fit this description.

You can make a quick test of the battery by shorting directly across the terminals, for an instant, with a wire or the handles of a pair of pliers or the blade of a screwdriver. If you get a barely perceptible spark or none, the battery is,

Specific Gravity Conversion Chart

Temperature	−10°C (14°F)	0°C (32°F)	10°C (50°F)	20°C (68°F)	30°C (86°F)	40°C (104°F)
Specific gravity	1.321	1.314	1.307	1.300	1.293	1.286
	1.311	1.304	1.297	1.290	1.283	1.276
	1.301	1.294	1.287	1.280	1.273	1.266
	1.291	1.284	1.277	1.270	1.263	1.256
	1.281	1.274	1.267	1.260	1.253	1.246
	1.271	1.264	1.257	1.250	1.243	1.236
	1.261	1.254	1.247	1.240	1.233	1.226
	1.251	1.244	1.237	1.230	1.223	1.216
	1.241	1.234	1.227	1.220	1.213	1.206
	1.231	1.224	1.217	1.210	1.203	1.196
	1.221	1.214	1.207	1.200	1.193	1.186
	1.211	1.204	1.197	1.190	1.183	1.176
	1.201	1.194	1.187	1.180	1.173	1.166

Specific gravity-temperature chart.

indeed, discharged.

Obviously you can re-charge it, if it is re-chargeable, but you will want to know why it is flat.

Battery

The small storage batteries in motorcycles are of low ampere/hour capacity and like all batteries, they are self-discharging in storage. Most manufacturers advise that stored batteries be charged once a month. Since many bikes are not used for several months at a time during the winter, this factor accounts for lots of complaints. Others are caused by carelessness in leaving lights on where this can be done with the key removed, direct shorts in wiring or faulty voltage regulator.

Do not, repeat *not,* have a motorcycle battery re-charged on a quick charger at your neighborhood service station. The charging rate is too high and the battery will be ruined.

Trickle-charge only, and then at a low rate such as 1.5 to 2 ampere/hours. You can go as high as 4 a/h for short periods. The battery will get pretty warm, but as long as it stays below 110° it will not be damaged.

Fill the battery to the specified level with water before re-charging.

After charging, check the specific gravity of the electrolyte. A 12-volt battery should register above 1.250 at ambient temperature of 68°. A 6-volt unit should be above 1.230. Specific gravity will be lower at higher temperature, higher at lower temperature, so allowance can be made if temperature is drastically different from 68°. (See accompanying chart.)

Voltage regulator

If the battery is consistently low and weak, the trouble may be in the voltage regulator. This is a simple electro-mechanical device between the generator and the battery designed to hold generator output to a specified voltage.

The regulator is an electro-magnet with a set of contact points spring-loaded against its pull. When generator output reaches about 15 volts (in the 12-volt system) or 7.5 to 8 volts (in the 6-volt system) the pull of the magnet is sufficiently strong to separate the points and interrupt the circuit. There is an adjusting screw which regulates the gap between the points and, thus, the cut-out voltage. In action, the points are in a constant state of vibration and a regular flow of current is permitted.

To check the regulator disconnect the battery lead. Then connect the negative lead of a voltmeter to the D terminal of the generator and the positive lead to ground. Start the engine and run it up to the point where the voltmeter stops flickering widely and settles down to a steady reading. This is the cut-out voltage and should be approximately the values given above.

If the voltage is low, shut off the engine and turn the right-hand adjusting screw slightly to bring the points closer together. If voltage is high, adjust the gap wider. It doesn't take much of a turn on the screw to affect the gap, so take it easy. Start the engine, re-check and adjust as necessary.

The output voltages given above are for ambient temperature of 60° to 80°. If it is hotter than 80°, lower the reading a bit, say by .5 volts. Or, conversely, if below 60° substantially, raise it a like amount.

In addition to improper adjustment, the regulator suffers from other ills:

Regulator problems

Here are some regulator troubles which can cause it to work improperly or not at all.

1. Dirty contact points
2. Burned contact points
3. Broken or shorted wiring in coil
4. Loose or bad connections
5. Poor ground

Vibration of the cycle causes most problems and if the regulator is not operating at all, search for bad connections first.

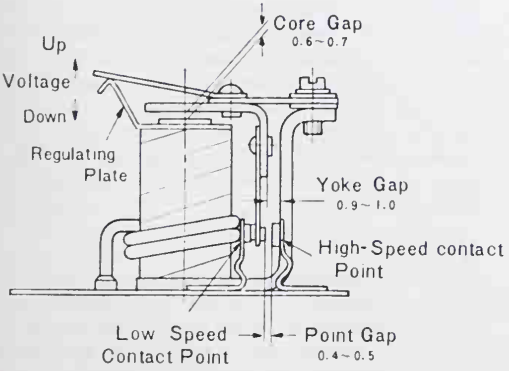
Dirty points can best be shined up by inserting a piece of paper or a business card between them and burnishing by rotating the paper or card. Burned points can be dressed with very fine emery cloth, used in the same way.

A check can be made for a bad coil by running the engine and holding the armature down so that points open. If they won't stay down the series winding is bad. If the coil pulls the contacts apart but voltage doesn't drop (as indicated by the voltmeter), the shunt windings are broken.

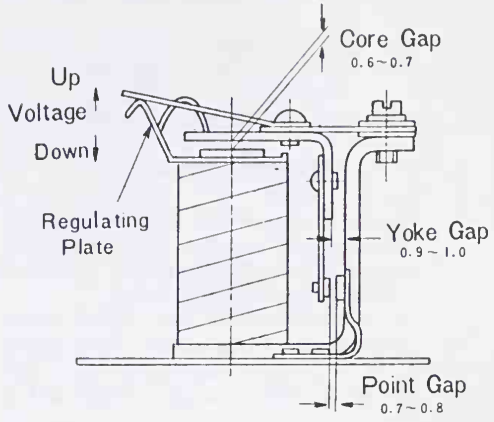
Cutout

The other part of the regulator is a cutout, a relay, which permits the flow of electricity in only one direction. The magnetic force exerted by its coil is used to overcome the resistance of a spring and close a circuit so that current can flow from the generator to the battery. Otherwise the circuit is broken, preventing current drain from the battery.

This cutout is relatively trouble free, except for occasional sticking points. It takes about 12.5 volts from the generator to make the cutout operate in the 12-volt system and about 6.5 in the 6-volt system.



Voltage regulator (typical).



Cutout relay (typical).

Complete DC system

This system uses generator-battery current to supply ignition needs as well as those of lighting. In nearly all cases, the generator is a starter-dynamo. The early Triumph Thunderbird is an exception.

The regulator, cutout and battery problems are the same as previously described, but the new element of coil and condenser enters the circuitry. Also, there is more opportunity for the battery to discharge because of the added connections.

Generator problems

If the battery is flat, the first place to check is the voltage regulator. Disconnect the battery from the regulator B terminal (or A if bike has an ammeter) and connect the positive lead of a voltmeter to the terminal. Ground the other lead, either at the regulator E terminal or a suitable spot on the bike.

Start the engine and run it up for a check on regulator output as described before. If there is no juice, check the generator output by keeping the engine running at about 3,000 rpm and removing the wire from the generator F terminal and grounding it for an instant. If voltage rises to over 25 v (for 12 v) or 13 v (for 6 v) then the generator is good and the regulator is at fault. If voltage does not jump up, the generator is bad.

Some Harleys have a voltage regulator, some do not. Those which have no regulator employ a three-brush generator of the type found on Model A Fords. This is a reliable setup and two field coils are used, one for ignition, the

other added when lights are turned on. The moveable (narrow) third brush controls output. Moving the brush in the direction of rotation increases output, moving it in the opposite direction reduces it.

Here are possible causes of generator trouble.

1. Poor connections or shorted terminals
2. Oil or water in case
3. Carbon dust from brushes is shorting out windings
4. Poor brush contact with armature
5. Worn-out brushes
6. Commutator of armature is dirty, pitted, or rough causing brushes to make poor contact.
7. The gaps between the armature commutator segments are filled with carbon.
8. Field or armature coils have broken wires.

For a quick test of the generator, try to motor it by closing the points of the cutout relay. This causes current to flow from the battery and it should spin.

Disassembly and examination of the generator should make any of the above conditions obvious except broken wiring. To check the field coil for continuity, a set of test leads is necessary. Remove the wires from F and A terminals and attach the tester. If there is no continuity, there is a broken wire in the field. If this tests o.k., check the wiring of the yoke for poor insulation which can be shorting.

The armature is tested for continuity by probing the shaft and the commutator. If there is continuity there is a short in the windings.

Dress the armature commutator with fine emery cloth and undercut the mica insulators with a pocket knife or a ground hacksaw blade so that the segments are clearly separated.

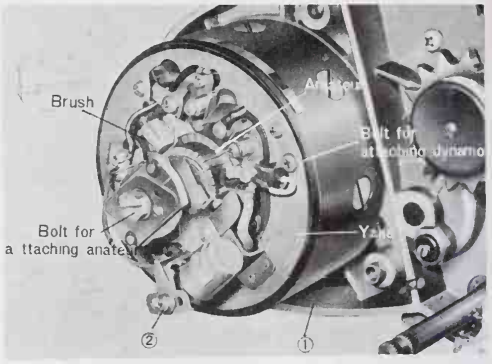
The presence of solder on the inside of the housing indicates that the generator is throwing solder and is shorted internally in the armature. Replace the armature if in doubt.

In replacing the generator, if it is necessary to replace a negative ground with a positive ground, or vice versa. Motoring the unit for a few seconds with the current from the battery will polarize it to the new polarity.

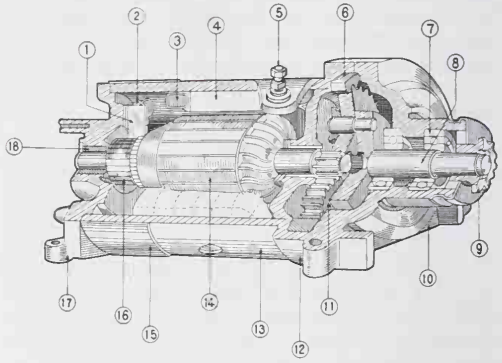
Starter-generator

This combination is not merely an arrangement where the generator is motorized. A generator has very little torque with the normal windings, so a starter-dynamo has two sets of field windings and brushes. The starter windings and brushes are much heavier than the generator components, but are subject to the same problems.

Poor internal connections can also plague the starter-generator and these units are more susceptible to carbon dust. Check the same items in the starter portion as in the generator portion visually and for continuity with the test leads.



Typical starter-generator.



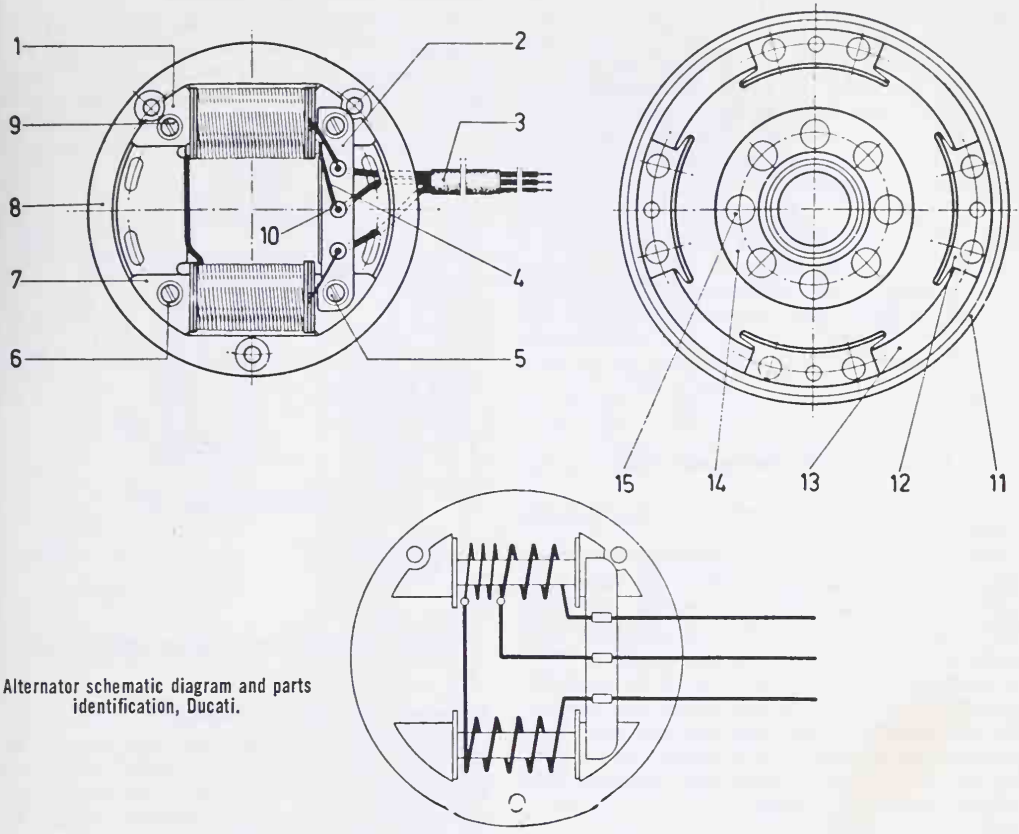
Starting motor. (1) Brush, (2) brush spring, (3) field coil, (4) pole core, (5) terminal, (6) internal gear, (7) ball bearing, (8) sprocket shaft, (9) sprocket, (10) gear housing, (11) planetary gear, (12) center bearing holder, (13) york, (14) armature, (15) cover band, (16) commutator, (17) commutator end frame, (18) bearing bush.

Separate starter

A separate starter is found on many modern cycles. It is analogous to the generator in its troubles and should be handled the same way. Starter drive chain wear and sprocket wear can be a problem on high-mileage bikes because the ordinary overhaul does not include a chain unless the condition is fairly critical. This may be the source of noise when starting, but most riders do not strip down to repair it until the chain or sprocket finally fails.

Alternator

The alternator is the modern outgrowth of the flywheel magneto and is the least troublesome, most efficient method of generating power in the small displacement machine. It is reliable in that there are no brushes or slip rings and no segmented commutator, also the rotor is a



Alternator schematic diagram and parts identification, Ducati.

Stator. (1) 1st charging coil, (2) terminal block, (3) low voltage three-pole cable, (4) insulating sheath, (5) coil fixing screw, (6) spring washer, (7) 2nd charging coil, (8) stator plate, (9) coil fixing screw, (10) tin-plated copper wire. Rotor. (11) Casing, (12) pole pieces, (13) magnet, (14) hub, (15) rivet.

permanent magnet and has no internal wiring.

Alternators are mounted on the crankshaft in some models, driven by the crank in others. The operation depends on the principle that if a magnetic field is interrupted a current is generated. In the alternator, the rotor spins inside a housing which has six coils mounted inside it. Current flows in one direction as the field is interrupted going in and in the opposite direction going away.

This is changed into direct current for use with storage batteries by a selenium or silicon rectifier or a Zener Diode, devices which permit the flow of current in only one direction.

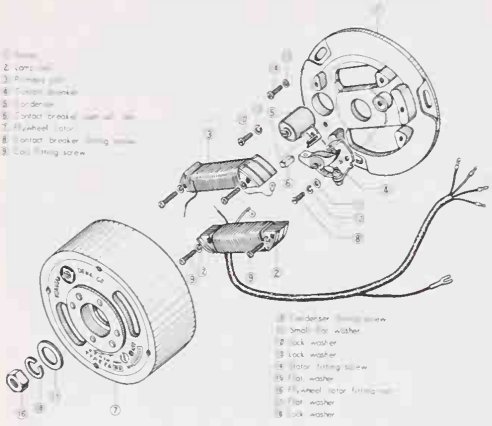
In some models, such as Honda 50-55 and 65cc, BSA, Suzuki 50, etc., an "energy transfer" system is used where the AC is fed directly to coil, points and plug for ignition and to headlight and taillight. DC is used for charging the battery which supplies juice for indicator lights, horn and stoplight.

In this setup the points are wired in parallel with the coil rather than in series and the points are fixed, timed to open at peak output of the current build-up, and so the current flows only one way through the coil.

This division of current is accomplished by a multi-position ignition and lighting switch which cuts the coils of the alternator in and out of the circuit. Generally two of the coils are wired into the battery-charging circuit, two to the ignition and two for lights.

Many AC systems are 6-volt, others are 12-volt, divided along displacement lines with the bigger models having the 12-volt system. BSA and others with Lucas 12-volt AC use a Zener Diode, rather than the rectifier.

To check the alternator output it is necessary to have an AC voltmeter and be able to operate the engine with supplementary battery ignition. In general a 6-volt alternator should put out about 4 volts from the "ignition" coils (first switch position) plus 2.5 additional for the second and 2 volts from the third. This is at about 3,000 RPM.



Exploded view of flywheel magneto (Suzuki).

Connections for test leads can be made as follows:

Disconnect the three alternator leads from the snap connectors and connect a 0–15 AC voltmeter with a 1 ohm load resistor in parallel with the three leads, each in turn. Low readings on any group of coils indicate that wiring insulation may be chafed or broken or that some of the turns of wire in the coils are short circuited. No reading for any group of coils indicates that they are grounded or an open circuit exists. Low reading for all coils can indicate that the rotor has become partly demagnetized.

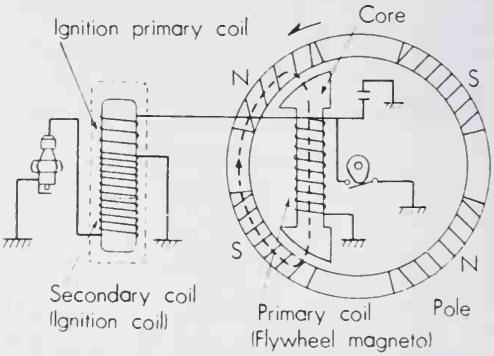
Lucas RM 13 alternator

The Lucas AC ignition system is connected to ensure a fully charged battery under all normal running conditions. In the case of machines fitted by the smaller Model RM13 alternator, the charge rate may not always be found quite sufficient to meet the requirements of low-speed town work, the running-in period, short winter runs involving long periods of parking with the lights on, and similar conditions. In this event, the charge rate can be increased by interchanging two of the three alternator cables where these are joined by means of snap-connectors to the main harness. To do this, switch off the lighting and ignition switches and disconnect the dark green and medium green cables by pulling these cables from their snap-connectors. The dark green alternator cable must now be connected to the medium green harness cable, and the medium green alternator cable to the dark green harness cable.

If, due to a change in running conditions, the battery is found to be overcharged, as indicated by excessive gassing of the electrolyte and a frequent need for topping-up, the original connections must be restored.

Rectifier and diode troubles

Heat is the enemy of these units. Keep the aluminum heat sink of the diode clean. Be sure the mounting bolt of the rectifier is tight. Don't take the battery out of the system and operate the bike for long periods with Hondas, particularly, because of the danger of overheating the rectifier.



Schematic of energy transfer ignition system (Suzuki).

Selenium or silicon rectifier

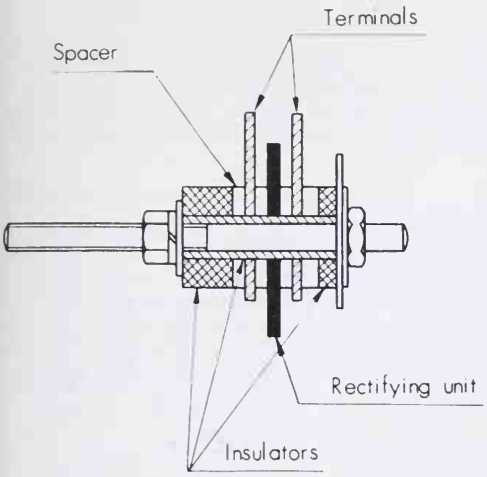
Rectifiers are generally fitted with two AC input connections and one DC outlet. On Lucas rectifiers the center terminal is the output side and other types are easily identified because of the disposition of the wiring.

To check the rectifier for continuity, simply connect one lead of a voltmeter in place of the battery lead and go to ground with the other. Then start the engine and read the voltmeter. It should pass 7 to 7.5 volts.

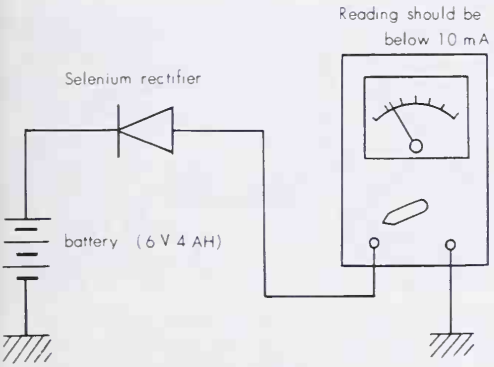
To check it for leakage (permitting DC current to flow back from the battery), connect the mounting bolt to the appropriate terminal of a battery (positive or negative depending on the ground arrangement). Then, using a .05 amp test bulb, or similar bulb, complete a circuit from the other battery terminal to the AC terminals of the rectifier in turn. If the bulb lights, there is excessive back-flow and the rectifier is not valid.

Zener Diode

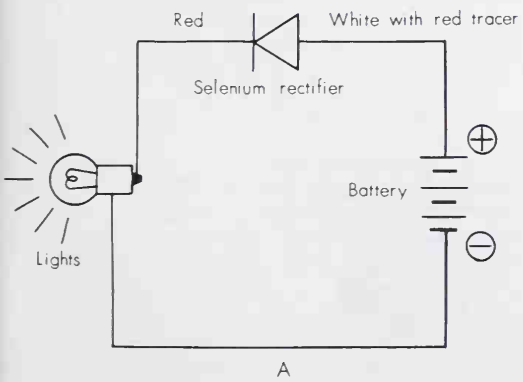
Assuming the battery is in a low state of charge its terminal voltage (the same voltage as across the diode) will also be low. Therefore, the maximum charging current will flow into the battery from the alternator: at first none of the current is by-passed by the diode because of its being non-conducting due to the low battery terminal volts. However, as the battery is quickly restored to a full state of charge, the system volt-



Sectional view of rectifier.



Checking rectifier for reverse current flow (leakage) with milliammeter—reading should be less than 10 ma.



Simple rectifier test is to connect in circuit with battery and light bulb.

age rises until at 14 volts the Zener Diode becomes partially conducting, thereby providing an alternative path for a small part of the charging current. Small increases in battery voltage result in large increases in Zener conductivity until, at approximately 15 volts, about 5 amperes of the alternator output is by-passing the battery. The battery will continue to receive only a portion of the alternator output as long as the system voltage is relatively high.

Depression of the system voltage, due to the use of headlamp or other lighting equipment, causes the Zener Diode current to decrease and the balance to be diverted and consumed by the component in use.

If the electrical loading is sufficient to cause the system voltage to fall to 14 volts, the Zener Diode will revert to a high resistance state of non-conductivity and the full generated output will go to meet the demands of the battery.

Testing the Zener Diode

The test procedure given below can be used when it is required to check the performance of the Zener Diode type ZD715 (supplied for 12-volt originally equipped and 12-volt converted motorcycles) while it is in position on the machine.

Good quality moving coil meters should be used when testing. The voltmeter should have a scale 0–18, and the ammeter 0–5 amps/min. The test procedure is as follows:

1. Disconnect the cable from the Zener Diode and connect ammeter (in series) between the diode Lucar terminal and cable previously disconnected. The ammeter red or positive (+) lead must connect to the diode Lucar terminal.
2. Connect voltmeter across Zener Diode and heat sink. The red or positive lead must connect to the heat sink which is earthed to the frame of the machine by its fixing bolts and a separate earth lead. The black lead connects to the Zener Lucar terminal.
3. Start the engine, ensure that all lights are off, and gradually increase engine speed while at the same time observing both meters:
   a. The series connected ammeter must indicate zero amps, up to 13.0 volts, which will be indicated on the shunt connected voltmeter as engine speed is slowly increased.
   b. Increase engine speed still further, until Zener current indicated on ammeter is 1.0 amp. At this value the Zener voltage should be 13.5 volts to 15.3 volts.
   c. Disconnect the battery while the engine is running, and slowly increase engine speed until Zener current indicated on the amme-

ter is 5.0 amps. At this value the voltmeter should indicate a Zener voltage of 12.0 to 15.0 volts.

Note: Test "c" should be carried out as quickly as possible to avoid overheating the Zener Diode.

If the ammeter in test "a" registers any current at all before the voltmeter indicates 13.0 volts, then a replacement Zener Diode must be fitted.

If test "a" is satisfactory, but in test "b" a higher voltage than that stated is registered on the voltmeter, before the ammeter indicates 1.0 amp, then a replacement Zener Diode must be fitted.

If in test "c" the Zener Diode does not pass 5.0 amps within the stated voltage limits, it should be replaced.

Checking the energy transfer system

To check out the AC coil in this system as used by BSA and others, it is necessary to take the alternator out of the system. If the engine is a twin two 6-volt batteries are needed and the hookup is made as follows in the BSA:

1. Disconnect the alternator leads.
2. Disconnect the black/yellow wire from the condenser at the right hand coil and connect it to the positive terminal of one of the batteries. Connect the negative terminal of the battery to the condenser.
3. Disconnect the black/white wire from the other condenser and connect it to the positive terminal of the second battery and the negative terminal of the condenser.

This assures a supply of current normally delivered by the alternator.

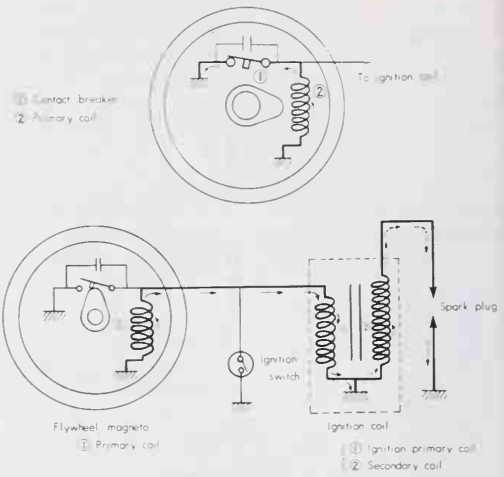
Remove the lead from one spark plug and open and close the breaker points a couple of times. If a spark can be induced between the lead and the plug or to ground, then the coil and condenser serving that plug are in good shape. If no spark, then substitute a known good coil or condenser.

This same procedure can be followed with any bike having this arrangement.

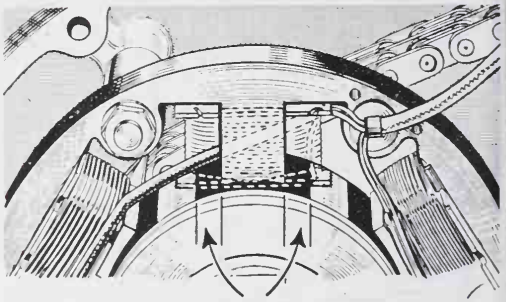
Note: It is very important to make this test as quickly as possible since these coils are not designed to operate on DC and can be overheated and ruined.

Miscellaneous alternator items

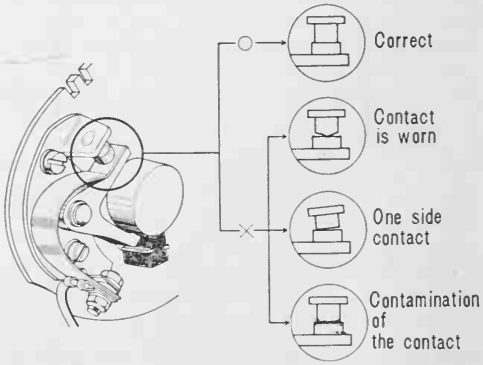
These are particularly trouble-free units, but the wiring and switches in some models cause problems since contact must be good. In addition, a slight movement in the switch can cause a change in alternator output by cutting in or out the various coils. Continuity and resistance tests can be run with shop equipment but the average rider must rely on visual inspection and deductive reasoning.



Electrical current flow in energy transfer ignition.



Critical timing of points with rotor is required in energy transfer system.



Breaker point contact conditions.

Less frequently encountered troubles include a loose rotor caused by insufficient tightening of the shaft nut and too little clearance between stator poles and rotor. This clearance should be approximately .007". Make sure pole studs are tight and not permitting poles to rub on the rotor.

Breaker points

Wear, the attrition of countless electrical discharges between the contacts, is the enemy of breaker points. Poor condensers hasten the end by not completely absorbing the current induced in the process. A build-up of metal ("transfer") on one point is an indication of poor condenser capacity, as are points which are blue from heat.

Points are cheap and easy to replace. Don't try to save them if they are far gone.

If you clean the points every 2,000 miles or so with fine emery cloth, or even just burnish them with a business card rotated between the closed contacts whenever you adjust the gap, they will survive much longer than if you ignore them.

If points burn consistently, check the connections at the battery and ground. Excess voltage diverted to points as the least-resistance path could be the trouble.

On twins, where two sets of points are used and it is necessary to alter the gap of one to match the timing on the other, this is permissible. It is better to have a variation in gap than in timing.

Likewise on magneto models, if gap is within .003", it is better to let it alone than to re-time the mag.

Distributors suffer from weakening of automatic advance springs and a general oil-soaked condition on motorcycles. Outside of cleaning the unit up, all you can do is replace the springs if it is a high-mileage unit. With the conventional distributor, scrutinize the bakelite cap for tracking, if poor ignition problems can't be laid at any other doorstep. This is really pretty rare although cracked and broken caps aren't. But they are also pretty obvious.

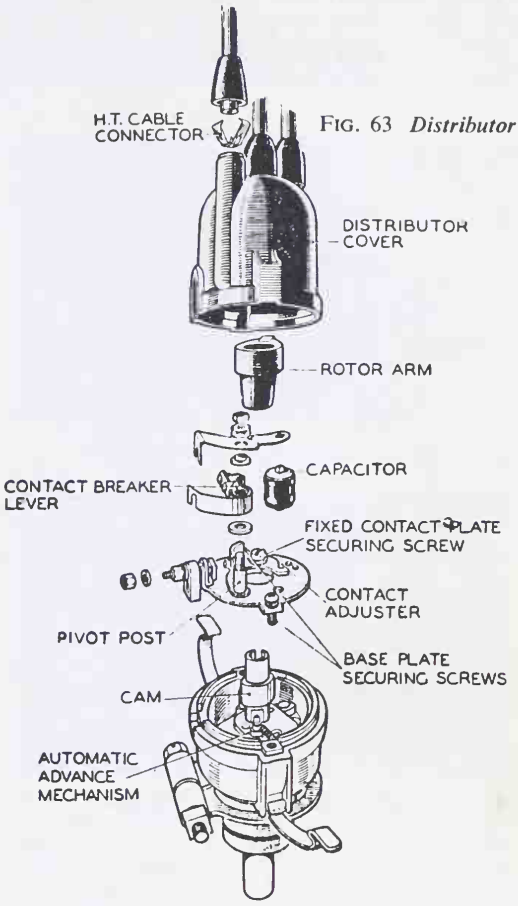


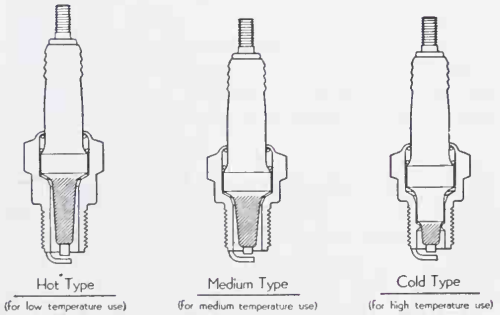
FIG. 63 *Distributor*

Conventional distributor as used on Norton.

Spark plugs

The spark plug is seldom worn out in service but generally fails because of imposed operating conditions. Carbon formation, lead fouling from gasoline additives and other destructive forces cause the electrodes to cease being the easiest path for current to follow.

Best advice about plugs is *replace rather than repair.* The accompanying illustrations disclose various plug conditions and causes. A study of them and a comparison between the photos and your bike's plugs will do much to educate you on engine operating conditions.



Construction of plugs having different heat ranges.

Always use the plug recommended by the manufacturer for normal conditions. If the recommended plug is clearly too hot or too cold for the conditions your cycle encounters, go to the next step in the heat range. Set the gap right, keep it clean and you'll have fire if the rest of the ignition system is working.

Coil

Coils suffer from overheating, principally. Leaving the ignition on is an invitation to a melted coil since the current from the battery will flow through the points and into the coil. To check the condition of a dubious coil, substitute a known good one.

Mixture too rich, plug too cold for conditions.

Mitxure too lean, plug too hot for conditions.

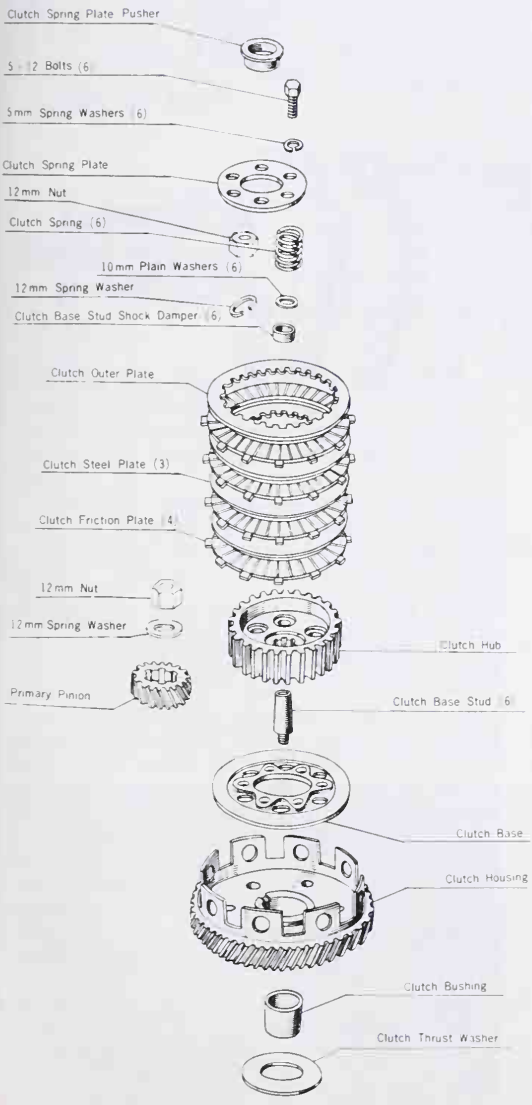
Plug of proper heat range, mixture good.

Oil-fouled plug.

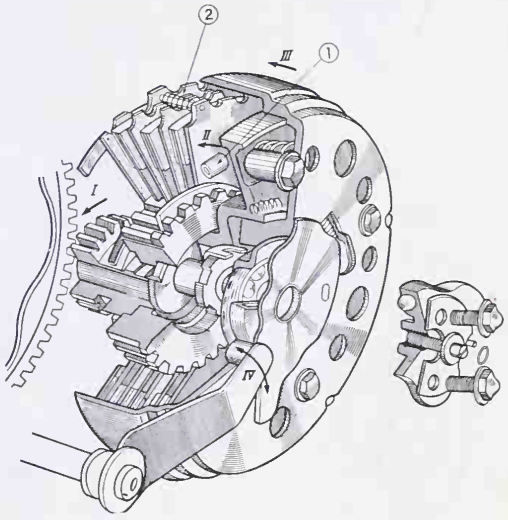
Chapter 4

Clutch and Transmission

Clutches and transmissions on the modern motorcycle can be said to be highly developed and relatively trouble free—in contrast to the general situation a generation of riders ago.



Exploded drawing of Kawasaki clutch.



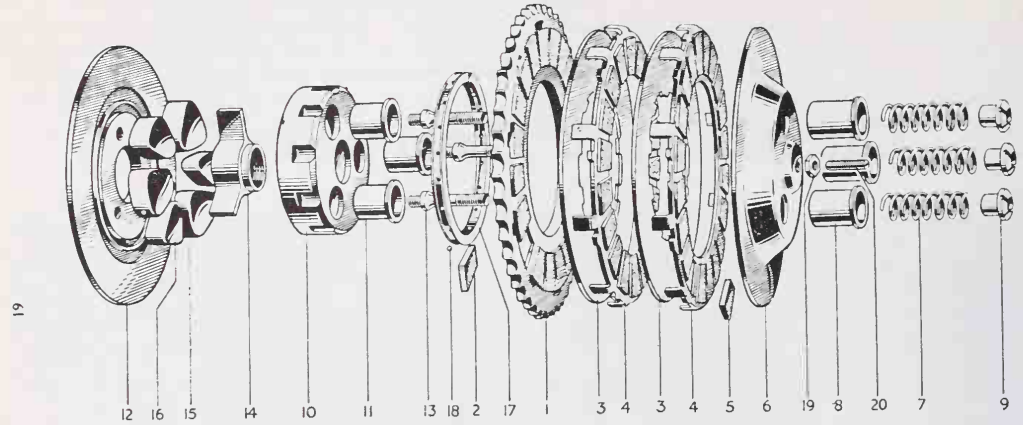
Cutaway view of Honda centrifugal clutch.

The modern unit-box is of the constant-mesh variety and greatly simplified. Clutches are almost all of the same pattern, wet multi-plate on the countershaft, with some centrifugally operated types on the smallest displacement models, and a lesser number of dry multi or single plate types.

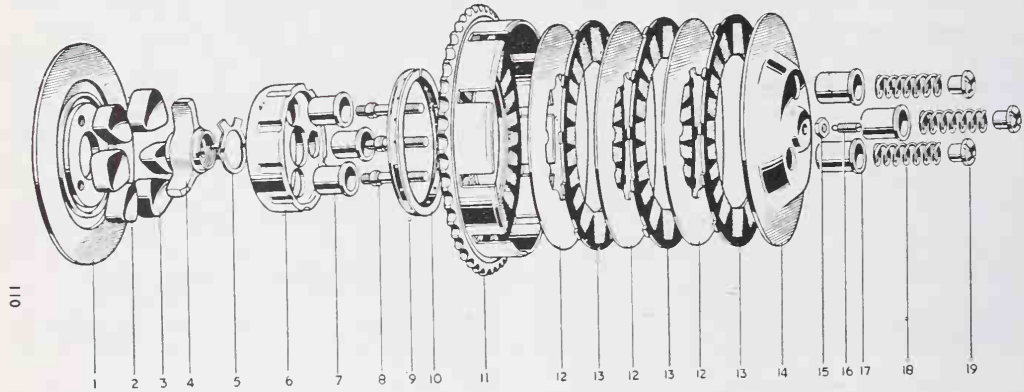
To get at the clutch or transmission means a strip-down on most Japanese machines and a fair amount of labor on the others. So it is best to be aware of the early symptoms of impending trouble and take corrective action, if possible, before the worst occurs. The best preventive medicine for clutches is to keep adjustment correct (with enough free play at the lever to allow complete disengagement), and to make gear changes with a blip of throttle instead of speed shifting. This is elementary advice, but if not followed, some of the following symptoms will be sure to show up.

① Engine speed increases when throttle is opened but machine doesn't

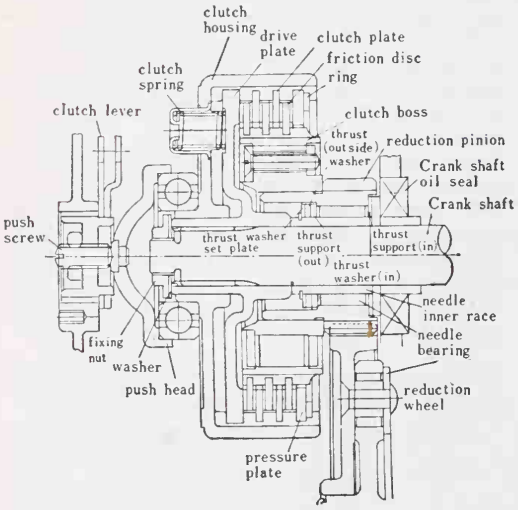
Caused by (a) insufficient spring pressure
(b) worn friction discs
(c) lack of oil if wet type
(d) too much oil if dry type
(e) not fully releasing



Early model Triumph clutch.



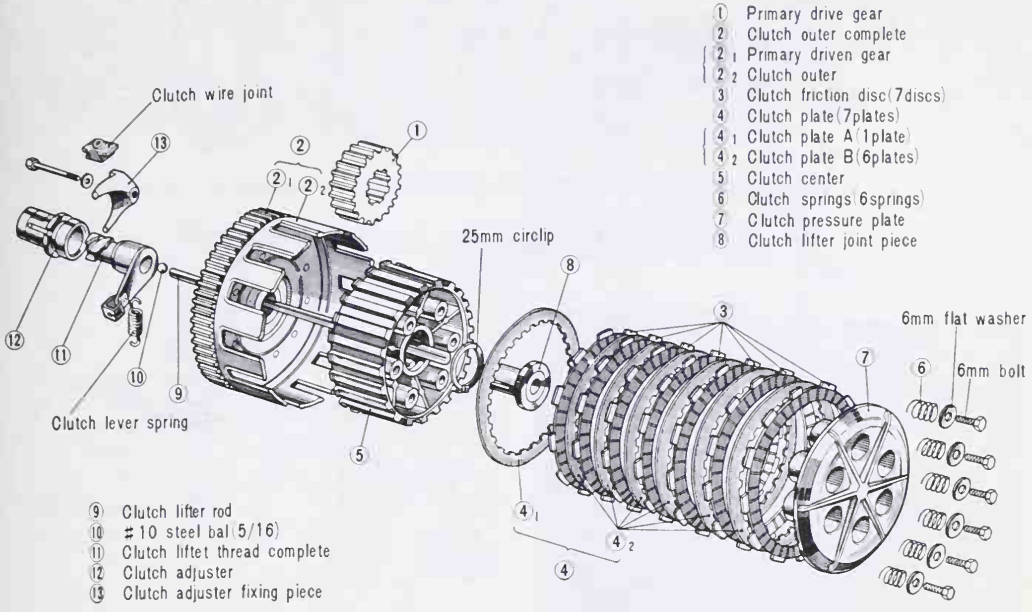
Later model Triumph clutch.



Clutch arrangement of Yamaha 250 models.

Let's take the least-serious first, lack of sufficient free play. There should generally be ½" or so movement at the outer end of the handlebar lever (or ⅛" clearance at the inner end) before the clutch actuating mechanism begins to do anything to the clutch. This can be adjusted at the lever: where the cable enters the housing and/or at the actuating mechanism inside the housing. It is important to make sure that there is no pressure on the release mechanism at the point of disengagement. Too much free play will result in difficult gear engagement, or more precisely, abrupt and grinding noises. If your setting of the free play adjustment changes one condition for another, you've gone too far and something in between is indicated.

In British bikes and others with rod-actuated clutch mechanism (see the Royal Enfield illustration), the screw which is at the end of the pushrod passing through the mainshaft must be unscrewed slightly if there is no actual free play. The clutch release cable must be slackened off

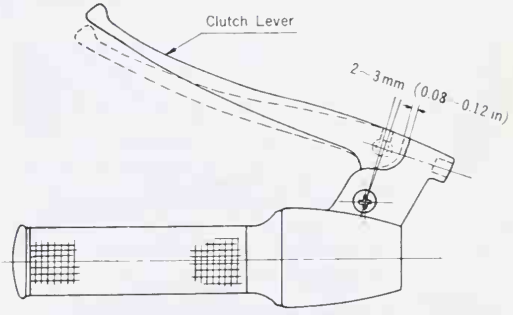


Exploded view of Honda 450 clutch, typical of all models above 90cc.

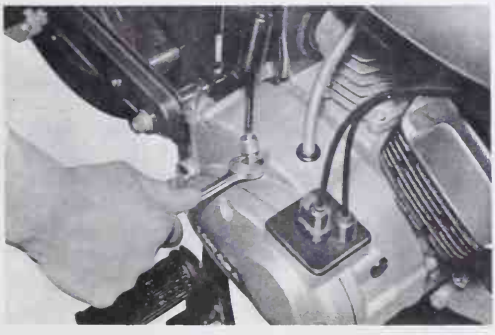
while this adjustment is made in order not to influence it. Clearance of 1/32" to 1/16" at the sleeve at the housing should be set and any slack in the cable taken up at the handlebar adjustment.

Insufficient spring pressure or worn friction discs are indicated if the adjustment is correct and the clutch still slips, particularly when speed shifting. Another time at which lack of binding pressure becomes noticeable, if you aren't in the habit of speed-shifting, is in kick starting. The clutch which is on the countershaft, as in most small bikes, is geared up to the mainshaft and torque is multiplied.

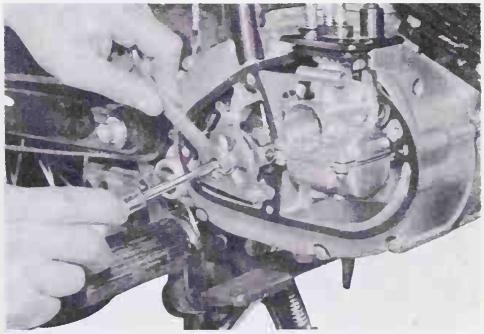
In case of poor friction discs there is little which can be done in the non-adjustable pressure



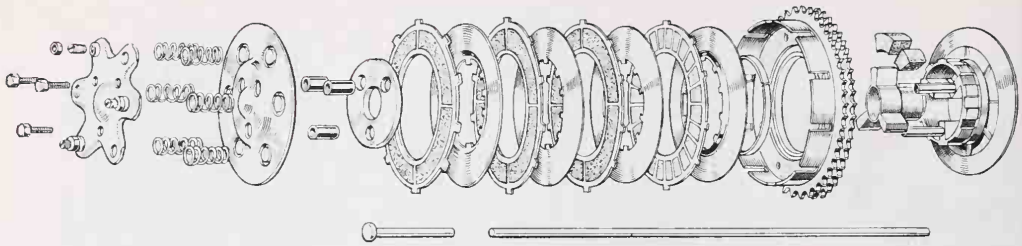
Clearance of 1/16" to 1/8" at inner end of lever is specified for Kawasaki clutch release.



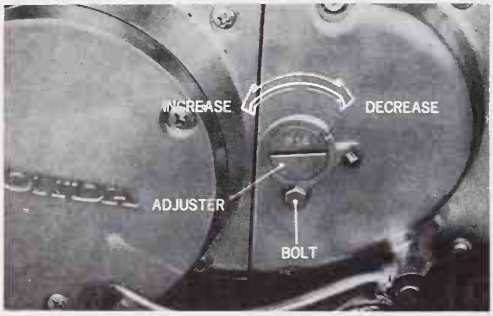
Adjusting clutch lever free play at housing on Kawasaki.

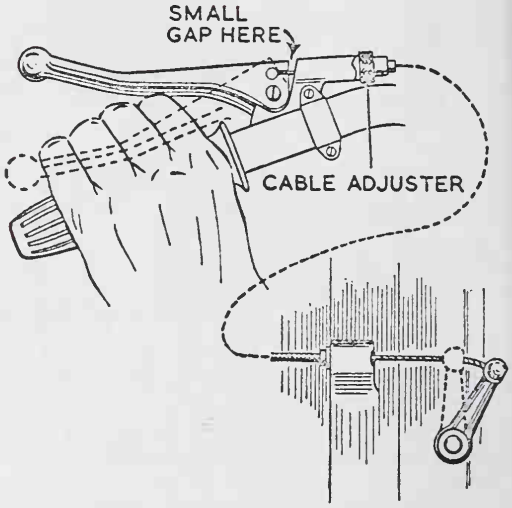


Internal clutch adjustment on Kawasaki. A quarter-turn of screw outward is nominal adjustment.

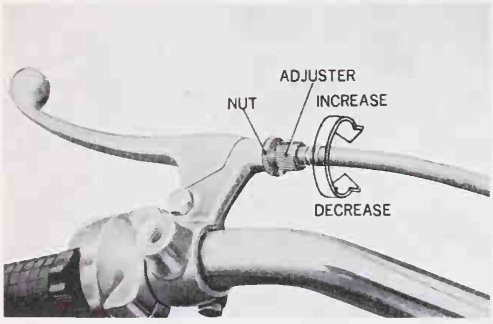


Exploded view of Royal Enfield clutch, typical of pushrod-operated clutches.





BSA (and other British bikes) requires approximately 1/8" clearance at inner end of clutch release lever.



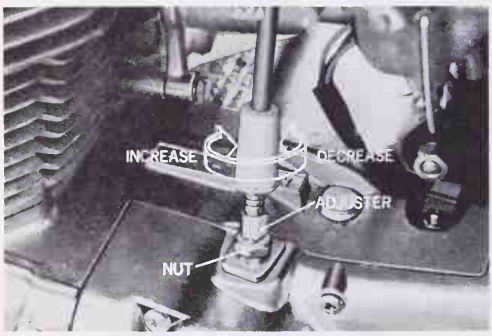
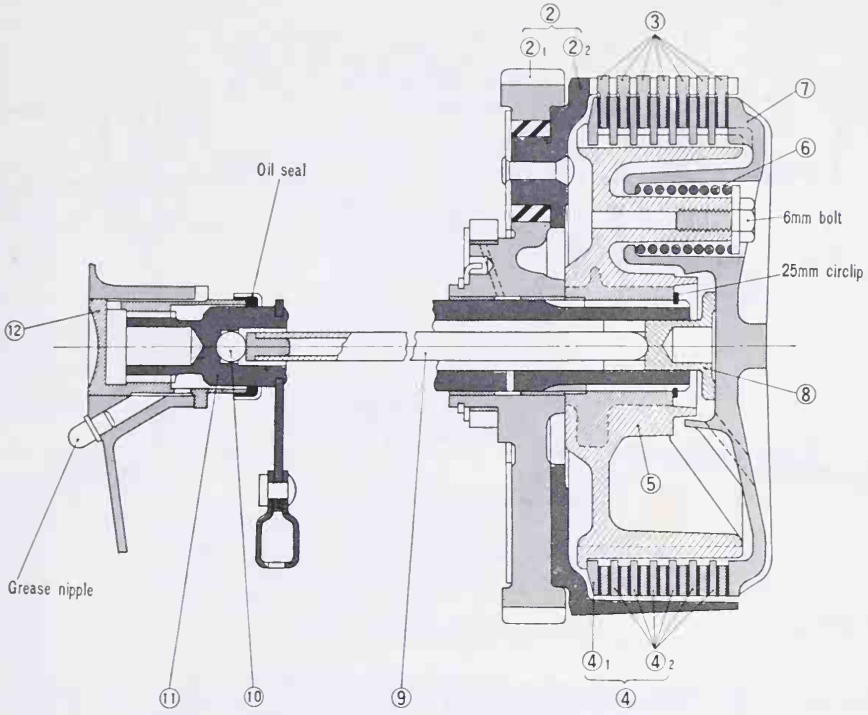


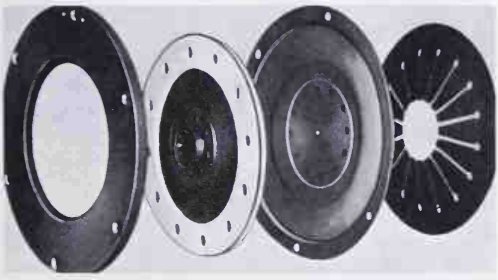
plate type except to replace the offending parts. In British cycles and others with adjustable release arms, you can tighten up on the screws and stall off an overhaul for some time if you don't let the slipping condition get out of hand.

The wet type clutch depends on oil for proper functioning. The dry-plate type can't stand it. The BMW, Ariel and such, with dry clutches tolerate a small amount of seepage from seals, but if they become oil-soaked, you've had it. A little oil can be burned off by slippage, which generates heat, they say, but getting exactly the right amount of heat this way to cure an oily clutch is more apt to be luck than science. If you are hard put to locate a clutch disc for your not-so-common dry-disc job, you can soak the friction material in solvent (not gasoline), or carbon tetrachloride CCl_4, or even boil it in a strong solution of detergent to remove the oil.

With the wet-plate type, keep the oil level in the chain case right on the mark. Use the rec-



Clutch adjusting mechanism (internal) of Honda.

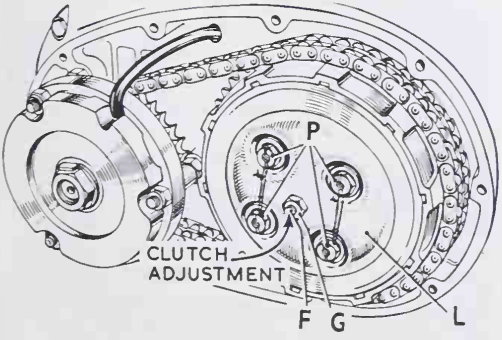


Single-plate dry-disc clutch with diaphragm spring used in BMW.

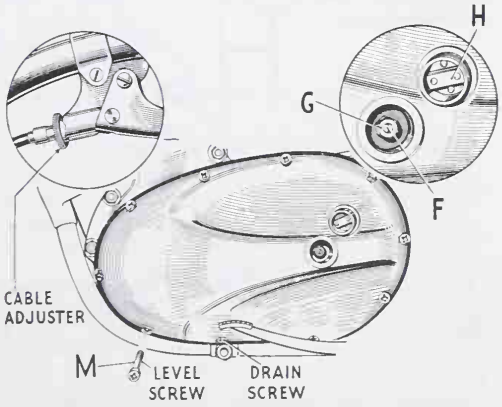
ommended weight oil, and, if in doubt as to what it should be, it is no crime to experiment. The lightest oil you can use without problems is the best.

② Gear grinding when shifting

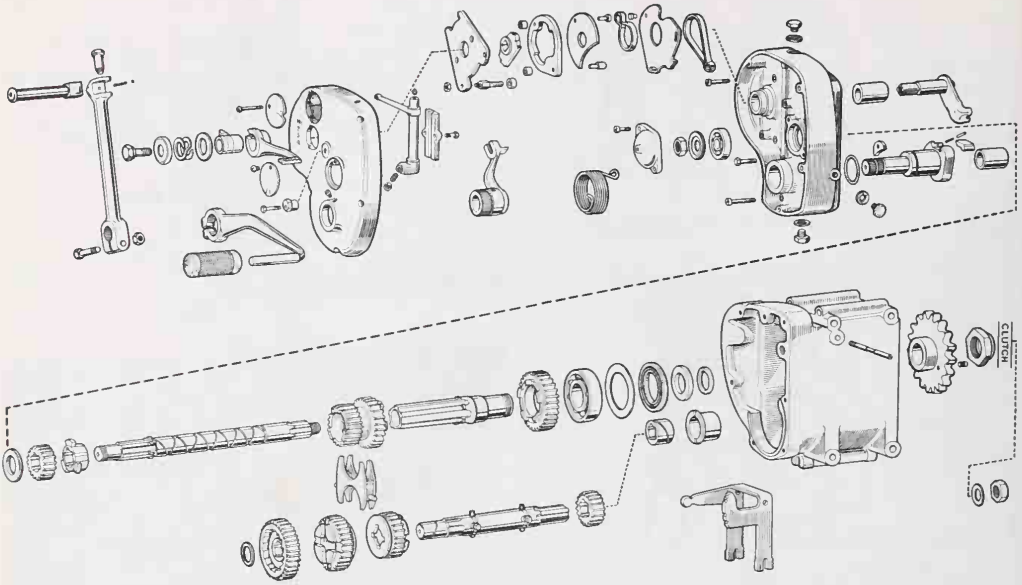
This symptom generally stems from clutch sources rather than transmission problems. The prime possibility is failure to release fully. Too



BSA clutch pressure plate is retained by these four spring retaining nuts (P).



Locations of clutch adjustment points in BSA twins—F is the screw pin and G the locknut.

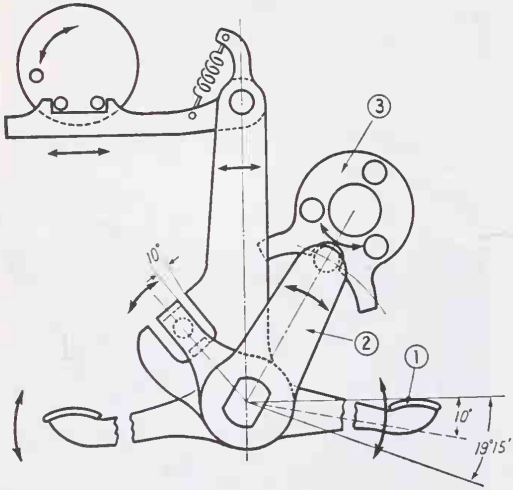


Exploded view of Royal Enfield transmission.

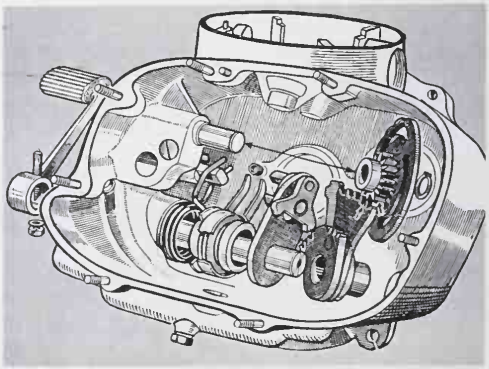
much free play in the clutch cable is the most probable cause. Cut down on the free play of the lever.

Again, be sure the adjustment mechanism at the case is correct. The point where pressure is just released should be between ½ and 1 turn of the adjusting screw on pushrod-release clutches.

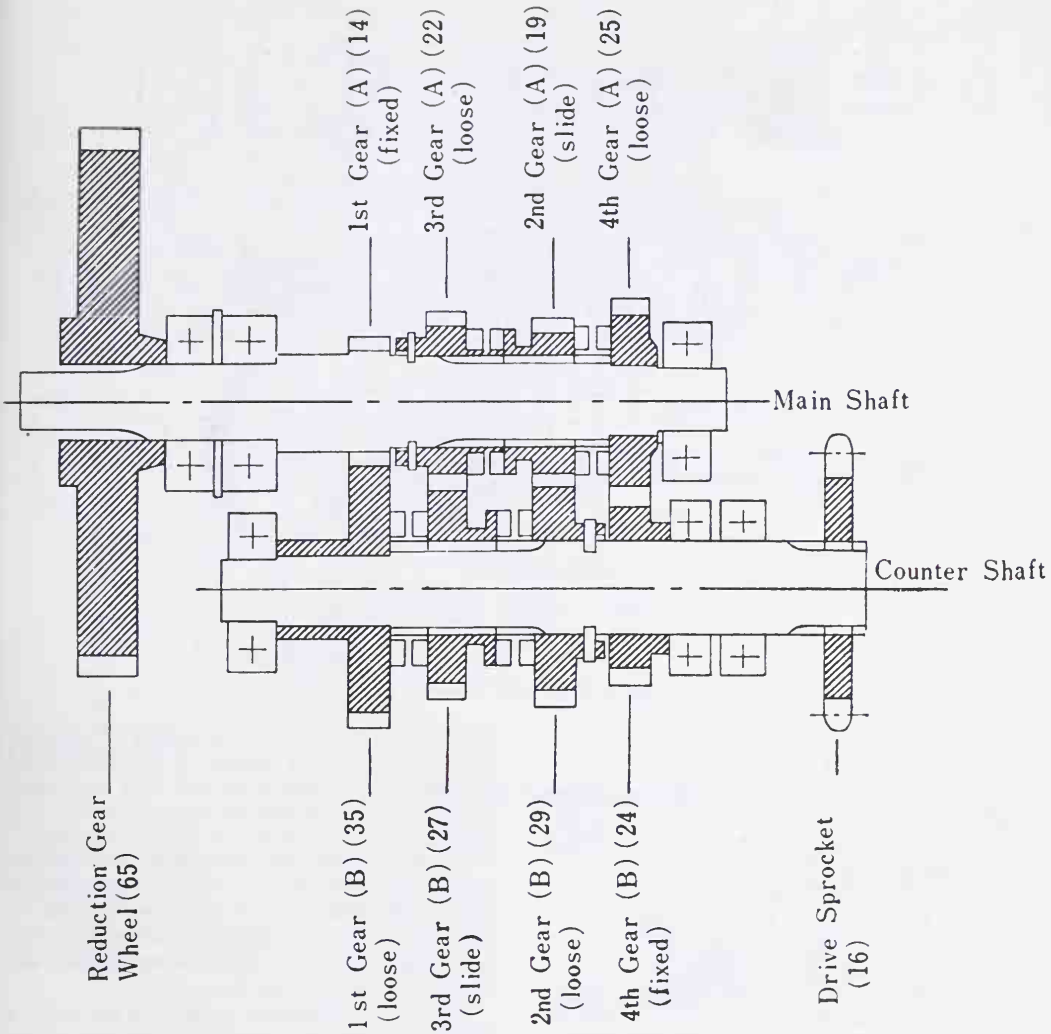
Gear change cam and ratchet in BMW transmission.



Operation of shift mechanism on Honda automatic clutch models—first 10° of shift lever movement disengages clutch, balance of movement changes gear.



Disposition of change mechanism in BMW box.



Powerflow of Yamaha 250 4-speed transmission.

Too much oil, or too heavy an oil will cause clutch drag and keep the discs spinning. If the condition clears up when the bike has been run for a few miles and warms up, suspect either of these two factors.

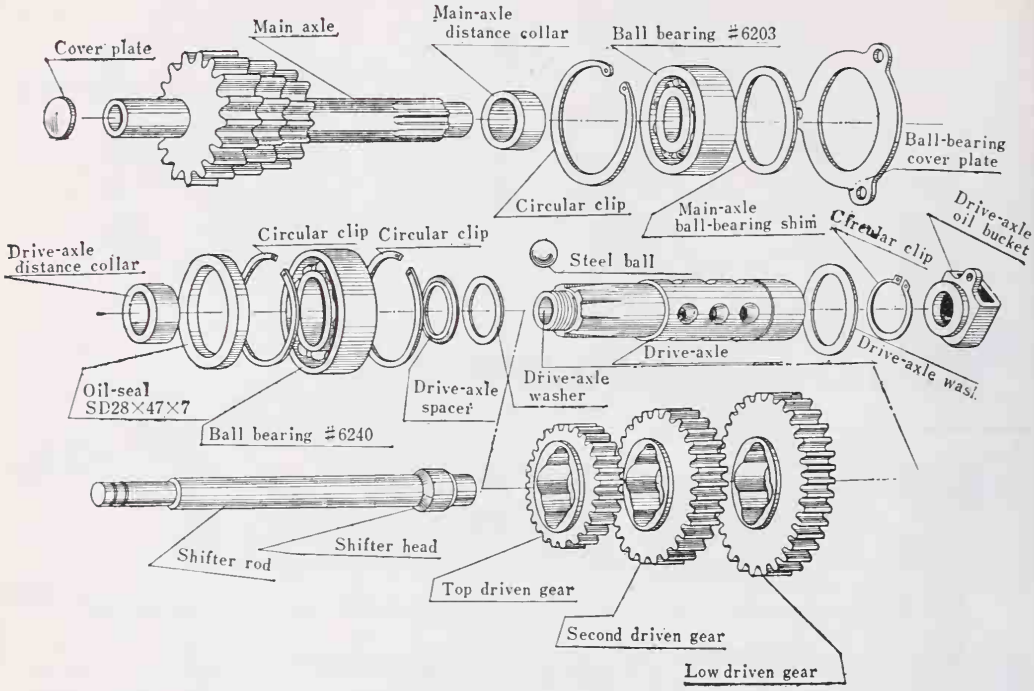
Uneven clutch spring pressure, causing partial non-disengagement, is present whether cold or hot and regardless of adjustment. Some clutch springs can be individually adjusted and are prone to this sort of malfunction.

If a clutch has been previously overhauled, there are other items to think about. In many clutches, such as Royal Enfield, clutch springs are fitted alternately, weak and strong, and in the models with adjusting screws, the strong springs must be behind the screws. Any miscue here can cause trouble.

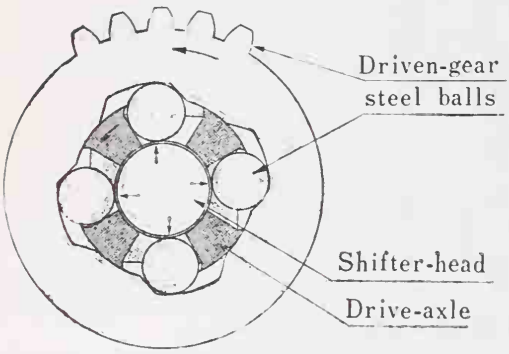
Riders who adjust the screws in the pressure plate arms to take up wear can overdo it and coil-bind the springs, which causes drag and poor releasing.

TRANSMISSIONS

The most common complaint about transmissions is difficulty in engaging a gear. As opposed to "gear grinding," this is in the transmission and is related to the shift mechanism and spacing of gears. As Honda riders know, finding neutral in some of the smaller displacement models is, at



Gearbox components, Yamaha MF-2.



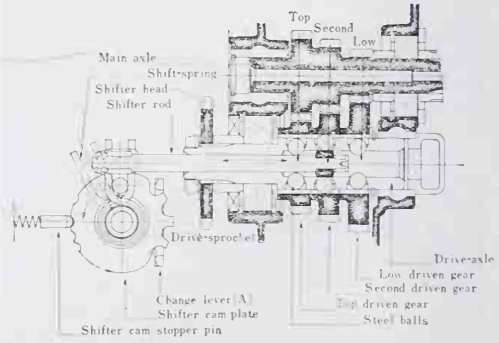
Gear pairing is accomplished by thrusting steel balls into internally-broached gear in small Yamaha.

Move-over spacer for Honda transmission stops jumping out of gear.

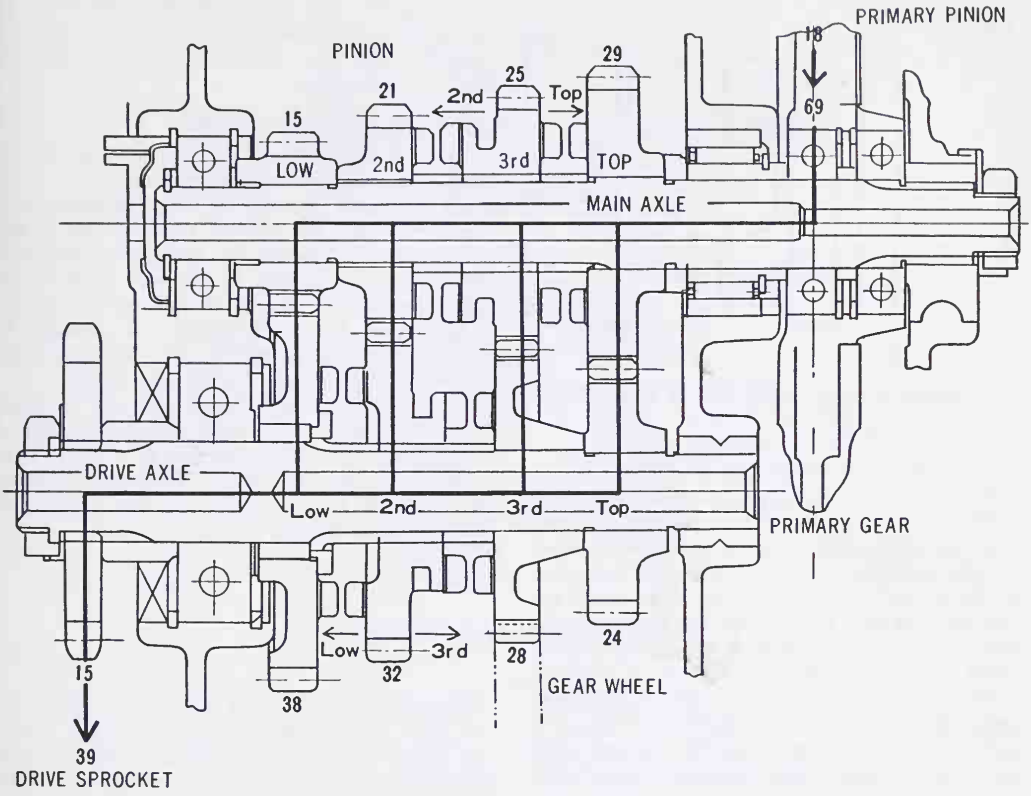
times, pretty frustrating. The spacing between the gears which must be engaged to achieve neutral is close and the shift lever and claw movement are more or less "geared up" for easy action, so a small amount of pedal action is hard to obtain.

When a gearbox gets older, a similar situation exists because of wear on shift forks, pins and spacers. In addition, hard usage bends forks. It all adds up to sloppy linkage and imprecise movement inside the box, so you overrun one gear and impinge on the next pairing.

There is no adjustment possible in the modern gearbox linkage, so if you are having real trouble



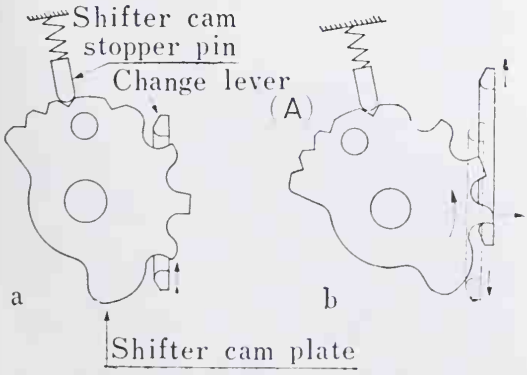
Simple and effective gear change method is employed in Yamaha 3-speed box.



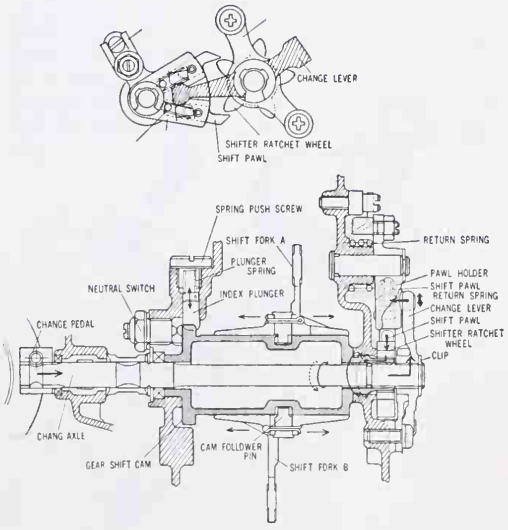
Powerflow in Yamaha 4-speed transmission of 125cc model.

finding a gear, it means a strip-down to get at the linkage and/or spacers, broken ratchet spring, etc.

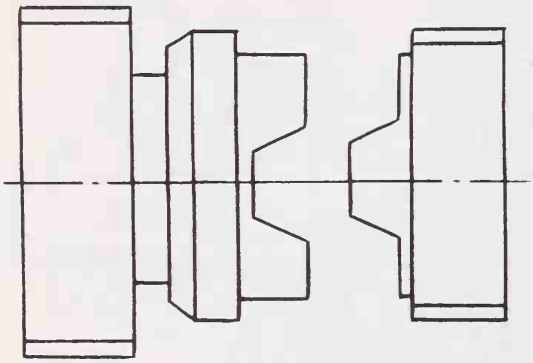
A close perusal of the accompanying illustrations of various gearboxes will make the operations clear and demonstrate the need for internal repairs.



Rotary motion is converted into linear motion by shifter cam plate. Wear in plate, stopper pin and change lever can account for jumping out of gear and difficult engagement.



Indexed cam moves shift fork to change gears in Yamaha 4-speed.



Gear engagement is by tapered dogs in Suzuki 3-speed.

① Transmission jumps out of gear

This means different things with different boxes. In the Japanese constant-mesh transmissions where gears are engaged by coupling with dowels, either the gear is not being shoved far enough into mesh or the dowels are worn off. In boxes which use plungers and balls for locating, the springs can be too weak, or engagement is not being forced. Worn cam plates in BSA boxes show up this way.

Worn spacers, particularly in Honda boxes, are responsible for the most complaints. There is a particular problem with Honda second gear spacers and a thicker one is available from Honda to correct the condition.

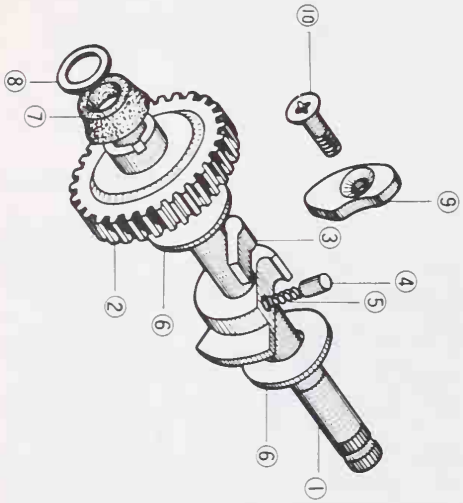
Worn or bent shift forks are also a prime cause, particularly in small displacement bikes which may have been ridden by inexperienced youngsters. Jamming the cogs into mesh when the clutch is maladjusted accounts for a lot of it. In Hondas, too, the shift drum limit spring can lose tension and create trouble.

② Transmission won't shift

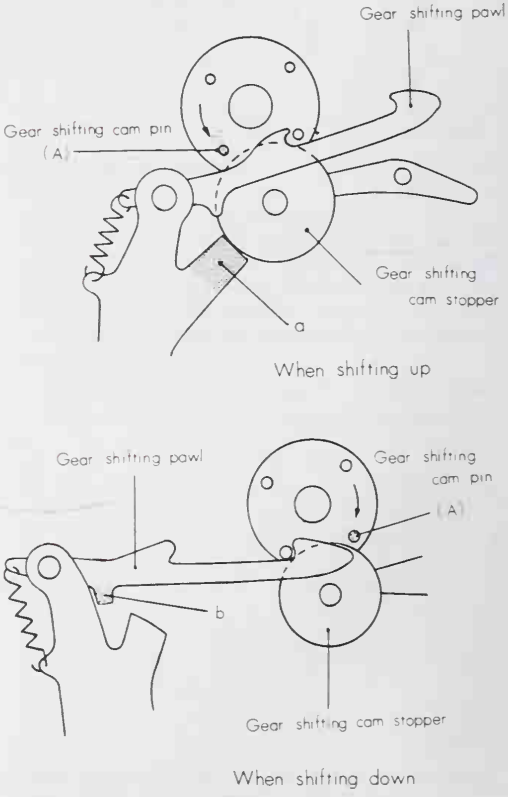
You are in for a strip-down anyway, but it might be good to know what to look for.

If the clutch operates but the shift lever won't move any gear, the pawl of the shift arm or the shifting fork is broken. Or, in the small displacement bike, the dowels on the end of the drum which engage the shift lever may be sheared off. This is rare, but it can happen. In addition, in various bikes, the numerous pins which provide the fulcrum points for linkage can break.

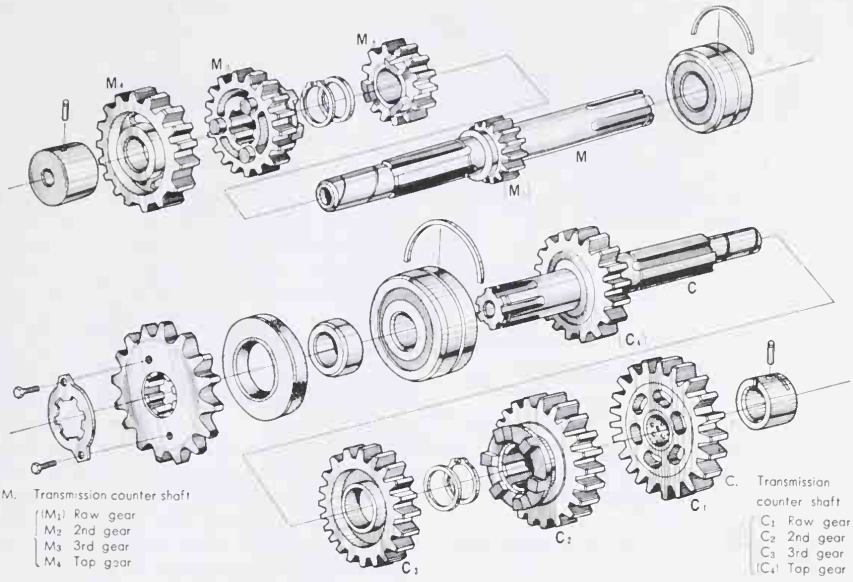
If you can get the box into one gear or more, depending on the type, then the problem lies in the engagement of the other gears: broken dowel pins, clutchdogs, etc. In the Honda, the countershaft second gear is usually the first suspect because it takes more of a beating.



Kick-starter mechanism of small displacement Suzukis.



Broken shift lever spring or worn pawl and pins can cause problems in Suzuki box.



Disassembled gears in Honda 450 box.

In the Royal Enfield and such boxes where the ratchet plays such an important part, a weak or broken ratchet spring can permit the shifter to slide right past a couple of gears and lead you to suspect the worst.

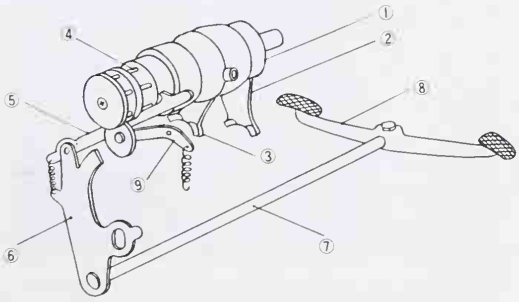
Seldom are gear teeth chewed up, but when breakage does occur, the resultant growling and howling or malfunction is pretty obvious.

Weak portion of Triumph box is layshaft pinion gear.

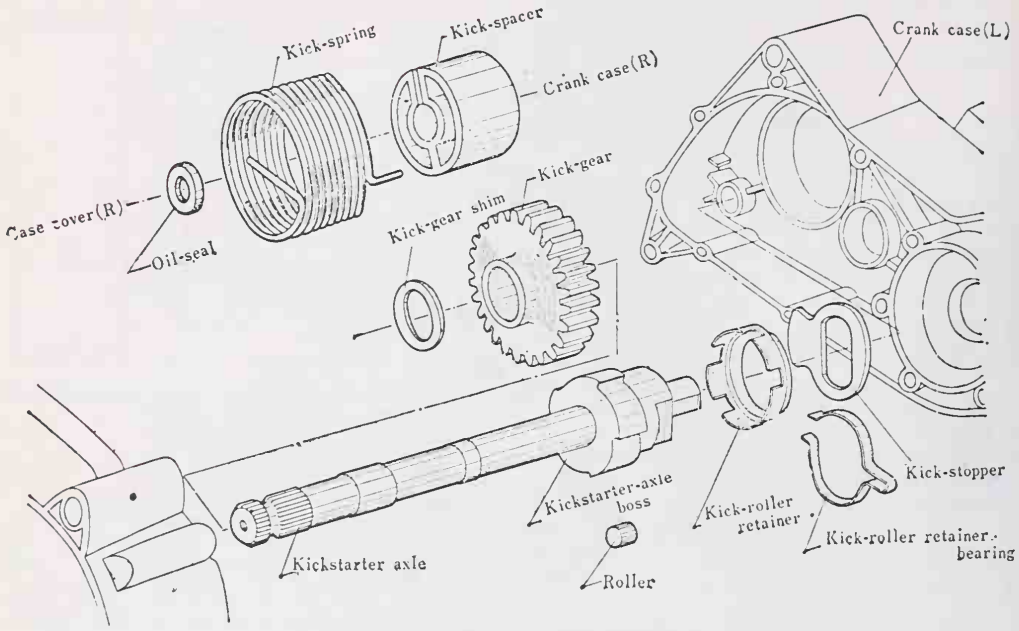
Drain the gearbox and examine the oil for bits of metal. Poke your little finger into the sump and run it around the inside of the case adjacent to the hole for the drain plug. If there are bits of metal, be prepared.

③ Jamming kick starter

The first tooth on the kick starter sector bears the brunt of service because it is the engagement point and if once fouled, it is more likely to continue to be chewed up. The tooth can be ground off if this is the only problem, rather than replacing the whole sector. If the pinion teeth are bad, the starter seldom jams, slippage is the symptom.



Gear changing mechanism of Suzuki 3-speed.



Kick-starter mechanism, Yamaha Moped MF-2.

④ Slipping kick starter

If the engine does not spin over in response to a kick, and there are grinding noises, worn out or broken sector or pinion gears can be suspected. If the starter doesn't want to engage, a worn ratchet pawl (in British cycles) is to be suspected.

If the return spring breaks and the pedal doesn't flip up, it should be replaced at once. Secure it in place while operating the machine. Accidental engagement can mean big trouble.

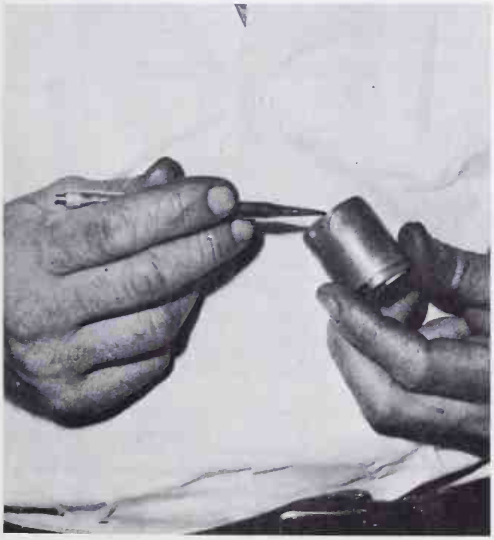
Chapter 5

Carburetors and Tuning

The carburetor is, if not the heart, at least the lungs of the motorcycle. It is tinkered with too much and not kept clean enough by most riders. There are only a few mechanics who understand carburetion enough to alter the factory settings and improve performance, yet nearly everybody takes the liberty to manipulate. Consequently, most carburetor trouble can be traced to the last "tune up" or the last time somebody fiddled with the carburetor.

A good understanding of each carburetor's mechanical method of coping with an engine's varied demands for fuel/air mixtures will help put you on the right track for troubleshooting. We will review each of the popular carburetors in the terms used by the manufacturers. Follow the thinking of the designer and you will better understand where and how trouble can crop up.

Amal carburetors have always been in the forefront of motorcycle fuel systems. Now, probably the Keihin is used on more individual cycles but the Amal is found in every corner of the world. Other carburetors of the slide-throttle type owe allegiance to Amal. They use different methods to attain the same ends in many cases, but the simplicity of operation and ease of service are all due to this concept.



Worn throttle slide causes problems in tuning Amal carburetors.

GENERAL CARBURETOR TROUBLESHOOTING

There are two possible faults in carburetion, either richness or weakness of mixture.

Indications of richness

① Black smoke in exhaust
② Fuel spraying out of carburetor
③ Four-strokes, eight stroking
④ Two-strokes, four stroking
⑤ Heavy, lumpy running
⑥ Sooty spark plug

Indications of weakness

① Spitting back in carburetor
② Erratic slow-running
③ Overheating
④ Engine runs better if throttle is not wide open or choke is partially closed.

If richness or weakness is present check if caused by:

a. Fuel feed. Check that jets and passages are clear, that filter gauze in float chamber banjo connection is not choked with foreign matter, and there is ample flow of fuel. Be sure there is no flooding.

Carburetor is usually tinkered with too much and not kept clean enough by average rider. Experts such as Mike Capalite advocate maintaining factory specifications.

b. Air leaks. These may be at the connection to the engine or due to excess inlet valve stem-guide clearance.

c. Defective or worn parts. Examples are a loose fitting throttle valve, worn needle jet, loose jets.

d. Air cleaner choked up.

e. An air cleaner having been removed.

Cable controls

See that there is a minimum of backlash when the controls are set back and that any movement of the handlebar does not cause the throttle to open; this is done by the adjusters on the top of the carburetor. See that the throttle shuts down freely.

Fuel feed

Some later model Amals and others are fitted with a filter gauze at the inlet to the float chamber. To remove the filter gauze unscrew the banjo bolt; the banjo can then be removed and the filter gauze withdrawn from the needle seating.

Be sure that the filter gauze is undamaged and free from all foreign matter. To check fuel flow, before replacing the banjo, turn on fuel tap momentarily and see that fuel gushes out.

Flooding

This may be due to a worn needle or a leaky float, but is more likely due to impurities (grit, fluff, etc.) in the tank; so clean out the float chamber periodically till the trouble ceases. If the trouble persists, the tank must be drained and cleaned out.

Fixing carburetor and air leaks

Erratic slow-running is often caused by air leaks, so verify there are none at the point of attachment to the cylinder or inlet pipe. Check by means of an oilcan and eliminate by new washers and the equal tightening of flange nuts. On later model Amals a sealing ring is fitted into the attachment flange of the carburetor. In old machines look out for air leaks caused by a worn throttle or worn inlet valve guides.

Backfiring in exhaust

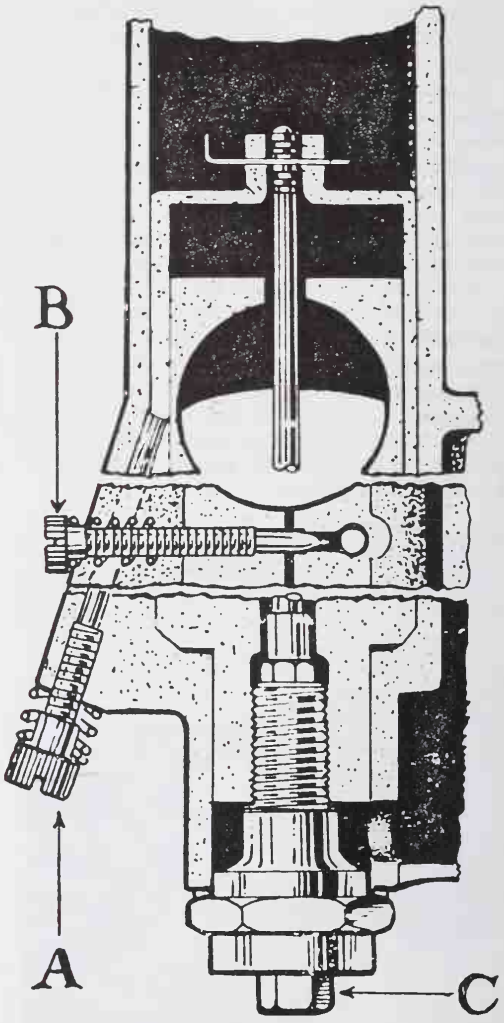
May be caused by too weak a pilot mixture when the throttle is closed or nearly closed. Also it may be caused by too rich a pilot mixture and an air leak in the exhaust system. The reason in either case is that the mixture has not fired in the cylinder and has fired in the hot exhaust header or muffler. If the banging happens when the throttle is fairly wide open the trouble will be ignition, not carburetion.

Excessive fuel consumption

If this cannot be corrected by normal adjustment, it may be due to flooding caused by impurities from the tank lodging on the float needle seat preventing its valve from closing.

It may also be caused by a worn float needle valve. High consumption will be apparent if the needle jet has worn. It may be remedied or improved by lowering the needle in the throttle, but if it cannot be, the only remedy is to get a new needle jet.

There are many other causes of high fuel consumption not connected with the carburetor.



Three variable parts of Amal: (A) throttle stop screw controls idle speed; (B) pilot air screw controls idle and low speed mixture; (C) main jet controls upper speed range.

Air filters

These may affect the jet setting. If a carburetor is set with an air filter and the engine is run without one, take care not to overheat the engine due to too weak a mixture. Testing with the choke will indicate if a larger main jet and higher needle position are required.

Effect of altitude on carburetor

Increased altitude tends to produce a rich mixture. The greater the altitude, the smaller the main jet required. Carburetors are set by the factory suitable for altitudes up to 3,000 feet (approximately). Carburetors used constantly for altitudes of 3,000 to 6,000 feet should have a reduction in main jet size of 5%, and thereafter for every 3,000 feet in excess of 6,000 feet altitude further reductions of 4% should be made.

No adjustment can compensate for lost power due to rarified air.

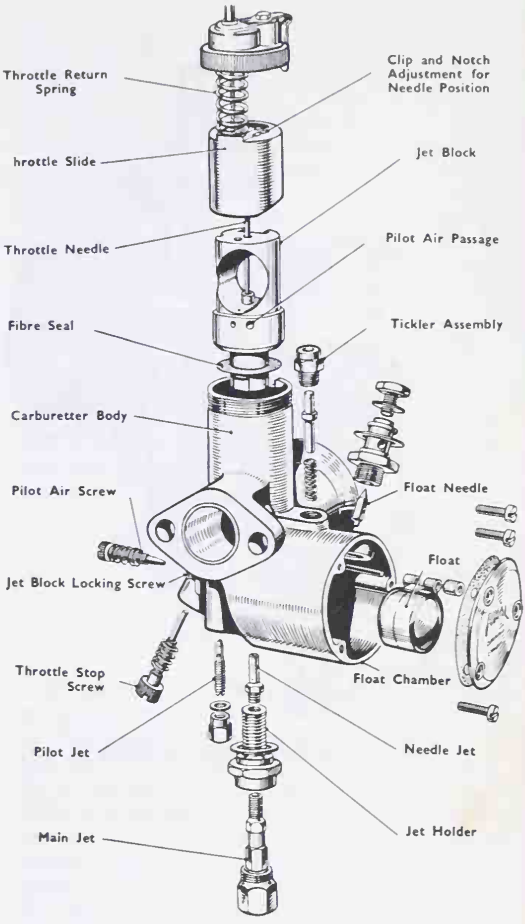
AMAL CARBURETORS

Monobloc-RN-TT-GP

The supply of air to the engine is controlled by a throttle slide which carries a taper needle operating in the needle jet. The needle is secured to the throttle slide by a spring clip fitting in one of five grooves and the mixing strength throughout a large proportion of the throttle range is controlled by the position of this needle in the slide and by the size of the jet in which it works. There is, however, a restricting or main jet at the bottom of the needle jet and the size of this controls the mixture strength at the largest throttle openings.

At very small throttle openings fuel and air are fed to the engine through a separate pilot system, which has an outlet at the engine side of the throttle. The air supply to this pilot system is controlled by the pilot air screw, and the slow running of the engine can be adjusted by means of this screw and a stop which holds the throttle open a very small amount.

The throttle slide is cut away at the back and the shape of this cutaway controls the mixture at throttle openings slightly wider than that required for slow running. There is a compensating system to prevent undue enriching of the mixture with increasing engine speed, this system consisting of a primary choke surrounding the upper end of the needle jet through which air is drawn in increasing quantities as the depression in the main choke increases. This air supply and the supply to the pilot system are taken from two separate ducts in the main air intake to the carburetor so that all the air passing to the engine can be filtered by fitting an air cleaner to the main carburetor air intake.



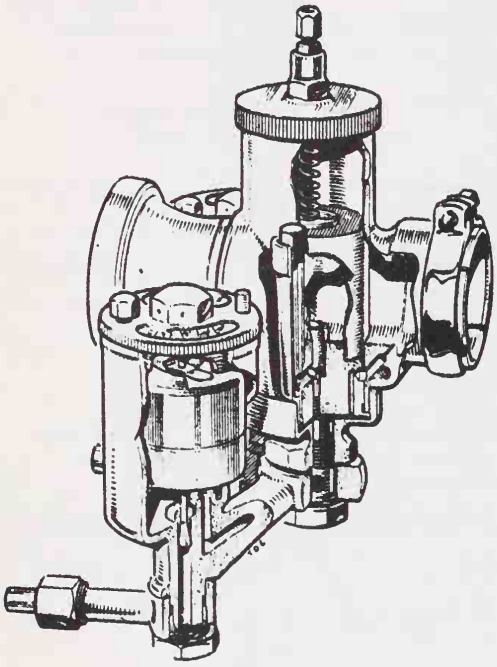
Amal Monobloc.

Two small holes in the needle jet, at a level just below the static level in the float chamber, permit fuel to flow into the primary choke when the engine is not running or when it is running at very low speeds, thus forming a well of fuel which will be drawn into the engine on starting or accelerating from low speeds. At moderately high engine speeds the level of fuel in the float chamber falls slightly and in consequence no more fuel flows through the cross holes in the needle jet so that the fuel well remains empty until the engine slows down or stops.

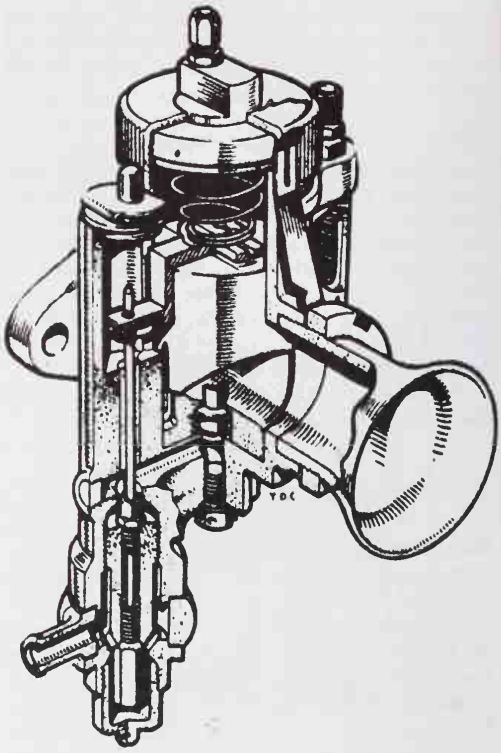
A handlebar-controlled air slide is provided to enrich the mixture temporarily when required.

Tuning the carburetor

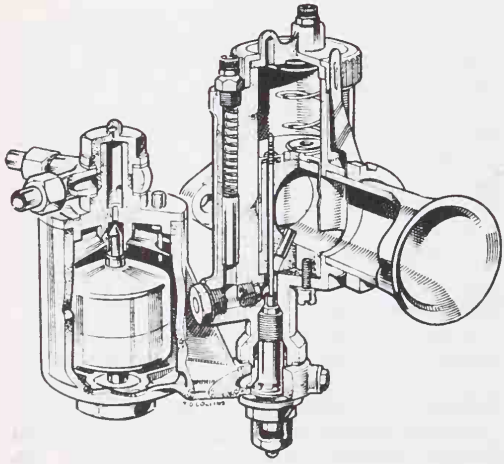
The throttle opening at which each tuning point is most effective is shown under TUNING SEQUENCE. It should be remembered, however,



Amal TT was developed for road racing.



Amal R.N. type.



Amal type 27 used in racing bikes.

that a change of setting at any point will have some effect on the setting required at other points. For instance, a change of main jet will have some effect on the mixture strength at half throttle, which, however, is mainly controlled by the needle position. Similarly an alteration to the throttle cutaway may affect both the needle position required and the adjustment of the pilot air screw. For this reason it is necessary to tune the carburetor in a definite sequence as follows:

① Main jet. The size should be chosen which gives maximum speed at full throttle with the air control wide open. If two different sizes of jet give the same speed the larger should be chosen for safety as it is dangerous to run with too weak a mixture at full throttle.

② The pilot air screw should be set to give good idling. Note that the pilot jet is detachable and sizes are available. If the pilot air adjusting screw needs to be screwed out less than half a turn the larger size pilot jet should be used; if the air screw needs to be screwed out more than 2–3 turns, fit the smaller size of pilot jet.

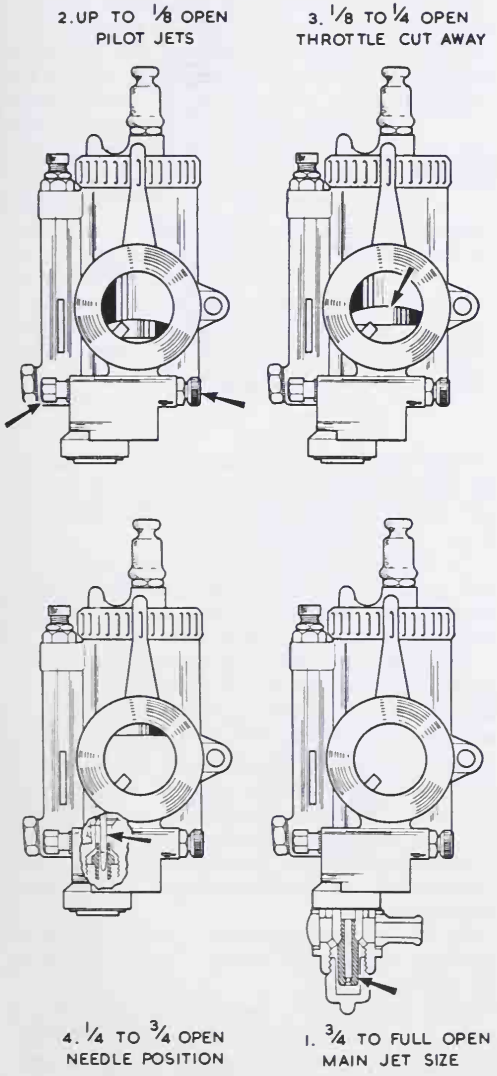
③ The throttle valve should be selected with the largest amount of cutaway which will prevent spitting or misfiring when opening the throttle slowly from the idling position.

④ The lowest position of the taper needle should be found consistent with good acceleration with the air slide wide open.

⑤ The pilot air screw should be checked to improve idling if possible. When setting the adjustment of the pilot air screw this should be done in conjunction with the throttle stop. Note that the correct setting of the air screw is the one which gives the fastest idling speed for a given position of the throttle stop. If the idling speed is then undesirably fast it can be slowed down by unscrewing the throttle stop a fraction of a turn. It will be noted that of the four points at which adjustments are normally made—pilot air screw, throttle cutaway, needle position and main jet size—the first and third do not require changing of any parts of the carburetor. Assuming that the carburetor has the standard setting to suit the particular type of engine any small adjustments occasioned by atmospheric conditions, changes in quality of fuel, etc., can usually be covered by adjustment of the pilot air screw and raising or lowering the taper needle one notch. If, however the machine is used at very high altitudes or with a very restricted air cleaner a smaller main jet will be necessary. The following table gives the reduction in main jet size required at different altitudes.

Altitude (ft.)	Reduction
3,000	5%
6,000	9%
9,000	13%
12,000	17%

In the case of carburetors for engines running on alcohol fuel considerably larger jets are needed. In most cases a #113 needle jet will be required and the main jet size will need to be increased by an amount varying from 50% to 150% according to the grade of fuel used. If the engine is run on fuel containing a small proportion of alcohol added to the fuel, a rough and ready guide is that the main jet should be increased 1% for every 1% of alcohol in the fuel.



Tuning sequence for all Amals.

Synchronizing two carburetors

When setting the slow running on machines fitted with two carburetors, the following procedure is recommended.

① See that both throttle slides are open the same amount for any given position of the twist grip. This is most easily checked by looking into the air intakes while slowly opening and closing the throttles with the air slides wide open. Make sure that the highest point of the cutaway on the throttle valve reaches the top of the bore simultaneously in both carburetors. If necessary adjust one or both mid-cable adjusters in the throttle cables.

② Repeat this procedure for the air slides.

③ Start the engine and let it run at a fast idle until thoroughly warm. Open the air slides fully and remove the high tension lead and waterproof plug cap from the right-hand spark plug, opening the throttle if necessary to keep the engine running on one cylinder.

④ Adjust the throttle stop on the left-hand carburetor to hold the throttle just wide enough open to keep the engine running with the twist grip shut.

⑤ Adjust the pilot air screw on the left-hand carburetor to give the maximum speed for this throttle position.

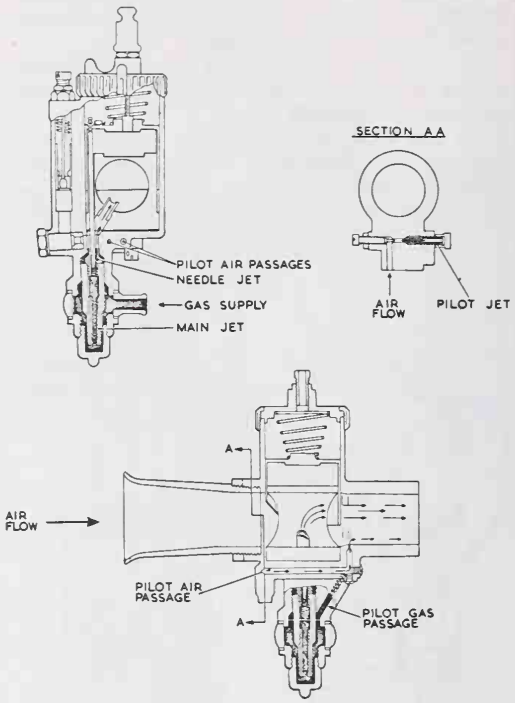
⑥ Slow down the engine as far as possible by adjusting the throttle stop and reset the pilot air screw if necessary to give the maximum speed for the new throttle position. Repeat until the engine is running as fast as possible on the smallest possible throttle opening.

⑦ Replace the right-hand plug cap and lead and remove the left-hand ones.

⑧ Repeat steps ④, ⑤ and ⑥ on the right-hand carburetor.

⑨ Replace the left-hand plug cap and lead. The engine should now be running steadily at a fast idle.

⑩ Slow the engine down by unscrewing each throttle stop equally. If running becomes lumpy, adjust each pilot air screw an equal amount. If necessary, slow engine down further by unscrewing each throttle stop equally but do not try to get too slow an idle with a hot engine, otherwise it will be liable to stop when only partly warmed up.



Fuel flow in Amal GP.

Dismantling and reassembling (Monobloc)

After removing the carburetor, the procedure for dismantling is the same whether for single or twin except that the twin carburetor cables are connected at junction boxes. Removal of the cable nipples from the junction boxes is quite simple and straightforward after the single cables have been disconnected from the lever and twist grip.

① Remove the throttle and air slides from the body by unscrewing the mixing chamber top cap, then withdraw the slides and throttle needle.

② Remove the needle retaining spring clip, compress the slide return, then push the cable nipple down and out of the slide.

③ To release the air slide, compress the spring and slip the nipple out of the bottom of the slide.

④ Unscrew three slotted screws and withdraw the float chamber cover and remove the float spindle bush and the float. Then withdraw the triangular section float needle.

⑤ Unscrew the banjo bolt which secures the fuel pipe banjo connector to the float needle seating block and withdraw the banjo, filter and junction washers. Unscrew the needle seating block. Unscrew the tickler body; then withdraw the tickler and spring.

⑥ Remove the air screw and throttle stop screw, then the main jet cover nut from the bottom of the body. Unscrew the main jet, main jet holder and needle jet. To release the jet block re-insert the main jet holder, until a few threads are engaged, then tap it with a hide mallet. This will release the jet block through the carburetor body.

⑦ Unscrew the pilot jet cover, and unscrew the pilot jet. All that remains to be removed then is the hexagonal locating peg, the end of which can be seen protruding within the mixing chamber.

Thoroughly clean all parts in solvent or carburetor cleaner. Deposits on the carburetor body are best removed by a light grade wire brush. It is advisable to wash the parts several times each in a clean quantity of solvent to avoid particles of dirt remaining. Allow the parts to drain, preferably using a jet of compressed air to ensure that all holes and drillings are free from blockage.

Apart from one or two points that are mentioned below, reassembly is a reversal of the above instructions.

Do not refit any paper washer. It is advisable to purchase replacement washers before removing the carburetor.

When replacing the jet block, ensure that the paper washer is in position; align the location slot in the jet block with the locating peg in the carburetor housing and drive the block home.

Finally, note that the float spindle bush fits on the outside end of the spindle, and that the float pressure pad is uppermost so that the float needle rests on it. Float level is marked by a small pip on float cover.

Inspecting the components

The parts liable to show wear after considerable mileage are the throttle valve slide, mixing chamber and the air slide.

① Inspect the throttle valve slide for excessive scoring to the front area and check the extent of wear on the rear slide face. If wear is apparent, the slide should be renewed. In this case, be sure to replace the slide with the correct degree of cutaway (stamped on top of slide).

② Examine the air valve for excessive wear and check that it is not actually worn through at any part. Check the fit of the air valve in the jet block. Ensure that the air valve spring is serviceable by inspecting the coils for wear.

③ Inspect the throttle return spring for efficiency and check that it has not lost compressive strength.

④ Check the needle jet for wear or possible scoring and carefully examine the tapered end of the needle for similar signs.

⑤ Examine the float needle for efficiency by inserting it into the inverted float needle seating block, pouring a small amount of gasoline into the aperture, surrounding the needle and checking it for leakage.

⑥ Be sure that the float does not leak by shaking it to see if it contains any fuel. Do not attempt to repair a damaged float. A new one can be purchased for a small cost.

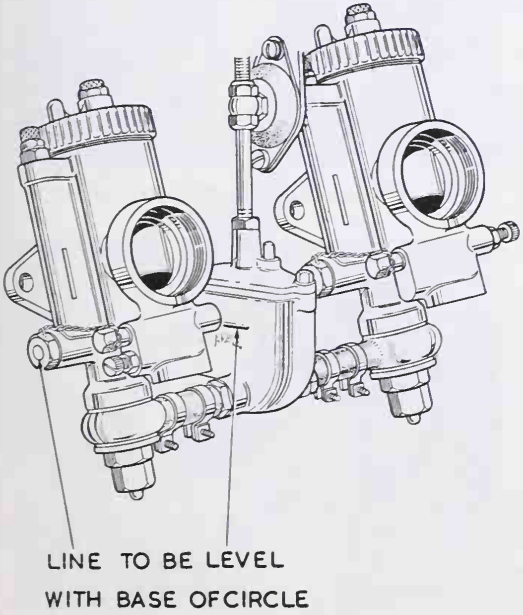
⑦ Check the gasoline filter, which fits over the needle seating block, for any possible damage to the mesh. Ensure that the filter has not parted from its supporting structure, thus enabling the gasoline to bypass unfiltered.

⑧ When replacing carburetor, do not overtighten the nuts and thus warp the body.

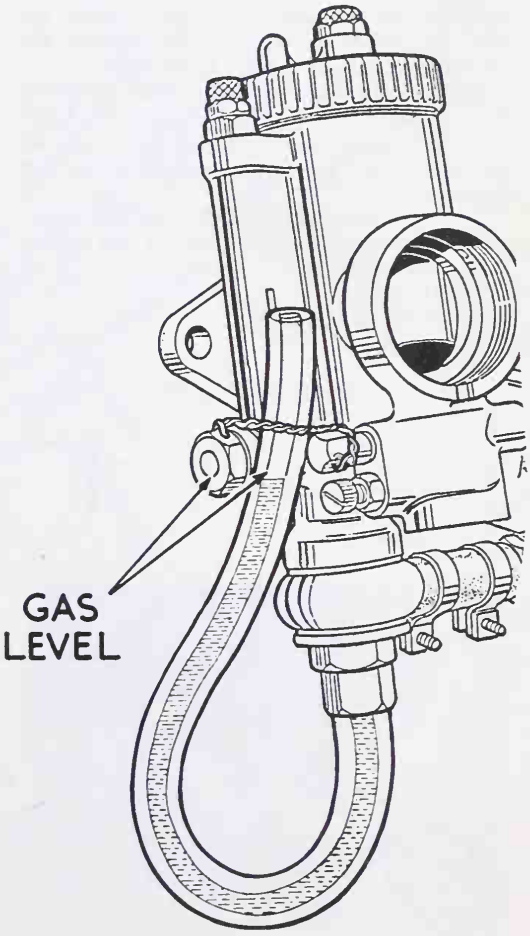
AMAL GP-2

This is the newest Amal. It follows the same principles as previous models but the location of the pilot jet has been changed.

The remote float bowl which is a feature of this model is mounted between the two carburetors when fitted to a twin such as the BSA Spitfire Mk. II.



Mounting of Amal GP on BSA Spitfire.



Finding fuel level using clear plastic tube—Amal GP.

The position of the float chamber relative to the two carburetors is adjustable by means of the rods on which it is suspended from its top mounting. The gas level in the chamber is indicated by a raised line on the outside of the body and in positioning the float chamber this line should be on a level with the lowest point of a circular scribed mark on the carburetor air jet plugs. The following illustration will make this clear to you and you will probably notice that with the float chamber in this position the short pipes connecting it with each of the twin carburetors are straight.

BING

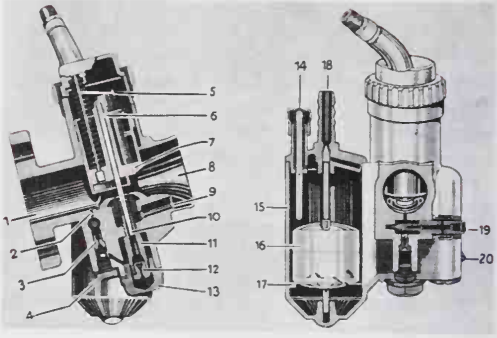
The Bing carburetor is known principally in this country because it is fitted to BMW models. It is essentially like the Amal. Here are directions for disassembly and adjustment:

① Disconnect intake air filter from transmission housing and remove the filter. Clean the filter element when necessary by tapping out the dust and replace it every 8,000 miles.

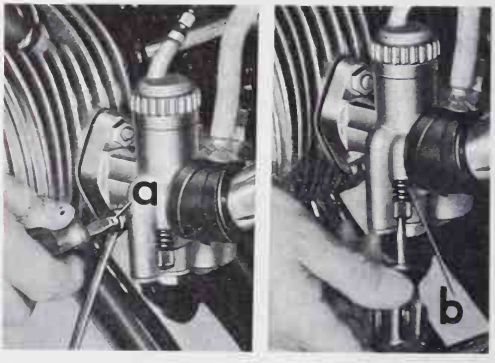
Note: When installing the air filter, remember the locating pin and make a correct fit. Upon removal of upper engine housing cover, lift out the filter screen, clean it with gasoline and wet it with oil.

② For removal and cleaning of the carburetor, unscrew the knurled ring on top and pull throttle slide upward and out.

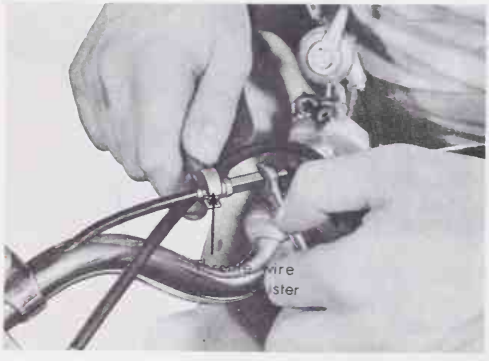
1. Intake port
2. Feed for idling mixture
3. Idling jet
4. Plug
5. Control cable with return spring
6. Jet needle holder
7. Throttle slide
8. Air intake pipe
9. Compensating air feed
10. Jet needle
11. Needle jet
12. Main jet
13. Plug
14. Priming button
15. Float bowl
16. Float
17. Damper ring
18. Hose fitting
19. Idling mixture adjusting screw
20. Throttle valve stop screw



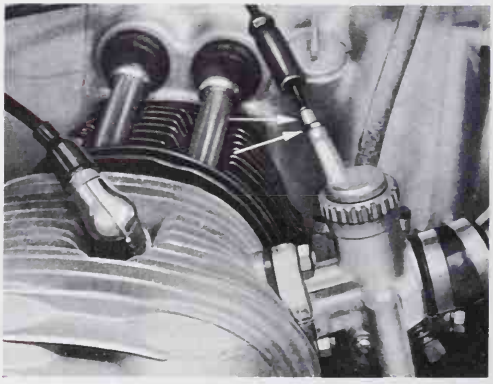
Cutaway of Bing carburetor used on BMW. Identification of parts is in text.



(A) idle mixture screw; (B) idle speed screw.



Throttle cable adjustment at handlebar.



Throttle cable adjustment at carburetor.

③ Air blast all passages and jets and reassemble parts properly cleaned and provided with new gaskets. For preliminary adjustment, screw the idling mixture adjusting screw fully in and then back it out one and a half turns.

④ To adjust the idling speed turn twist grip to idling stop position and adjust throttle cables on both carburetors for a play of .02".

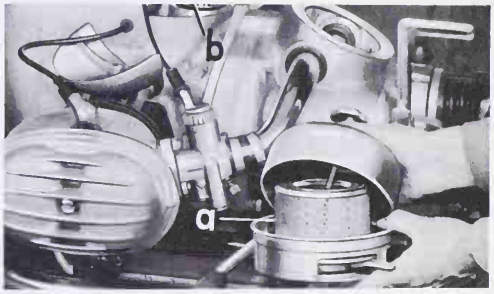
DELL ORTO

The Dell Orto carburetor is fitted to most Italian makes and operates like an Amal. Refer to that heading for information and service.

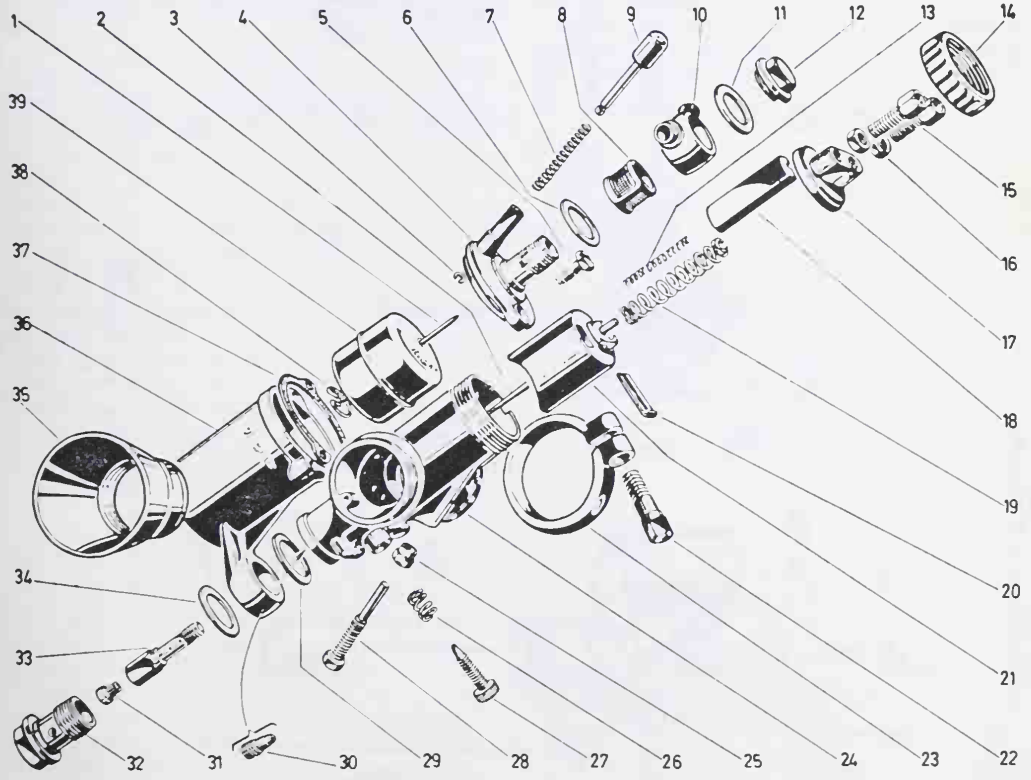
JIKOV

The Middle-European versions of the faithful Amal are used on JAWA motorcycles.

These are monobloc carburetors. The main jet is fastened at the end of the main jet bolt and it is accessible after unscrewing the main jet bolt. The idling jet is situated on the right-hand side above the pilot air serew. The throttle valve needle is located eccentrically in the throttle valve and becomes aeeessible after unserewing the mixing

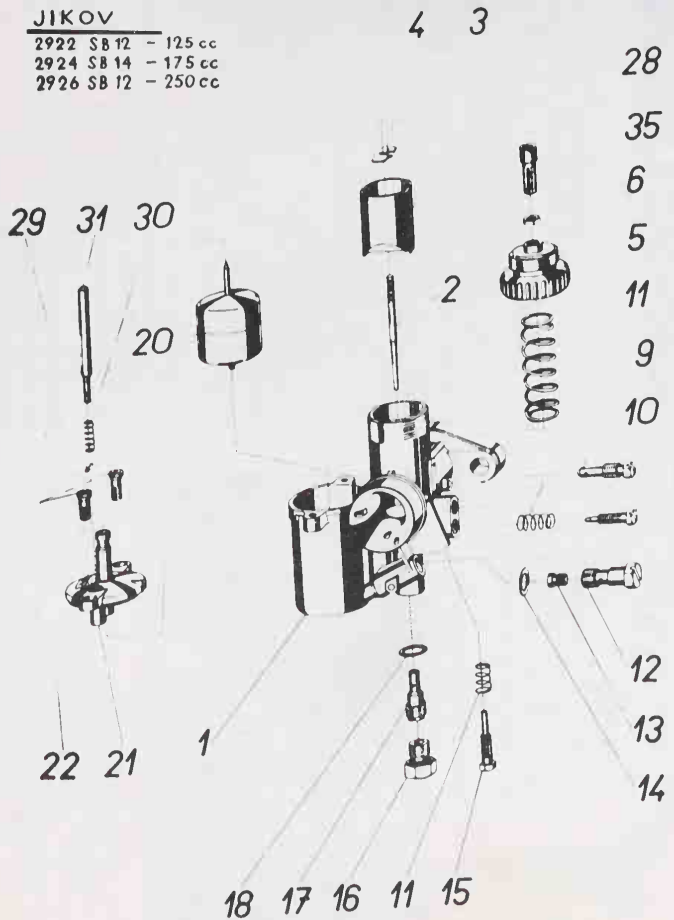


Filter removal on BMW.



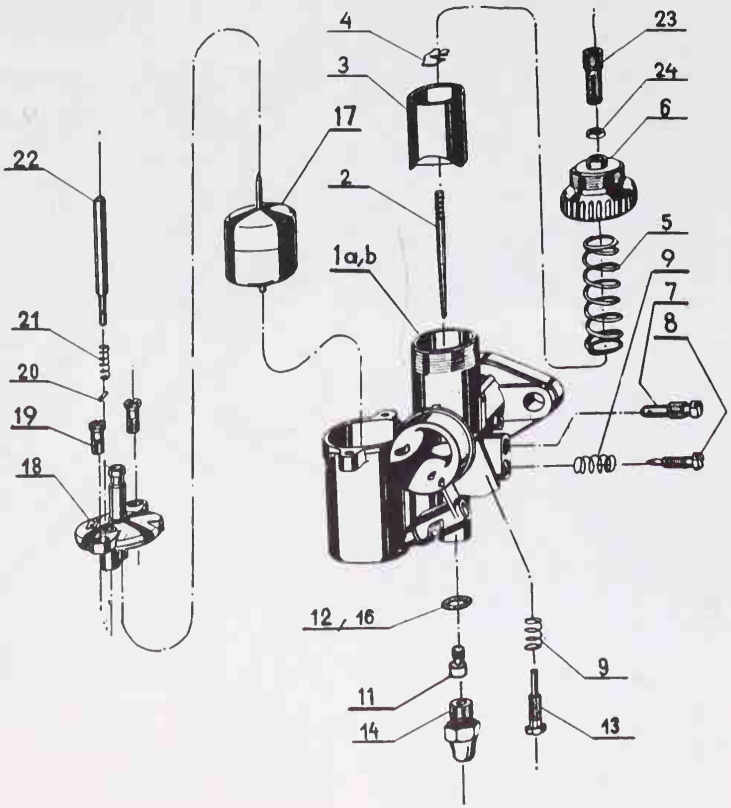
Dell Orto carburetor. (1) Tapered float needle, (2) tapered needle, (3) tickler retaining ring, (4) float chamber cover, (5) float chamber cover screw, (6) pipe union washer, (7) tickler spring, (8) gas filter, (9) tickler, (10) gas pipe union, (11) pipe union washer, (12) pipe union nut, (13) air slide spring, (14) throttle slide cover nut, (15) cable adjusting screw, (16) cable adjusting screw locknut, (17) throttle slide cover, (18) air control slide, (19) throttle spring, (20) tapered needle anchoring clip, (21) throttle slide, (22) ring clamp screw, (23) ring clamp, (24) carburetor body, left side, (25) throttle stop screw locknut, (26) pilot air screw spring, (27) pilot air screw, (28) throttle stop screw, (29) float chamber union washer. (30) slow running jet, (31) main jet, (32) float chamber union plug, (33) needle jet, (34) float chamber union washer, (35) air inlet, (36) float chamber, (37) float chamber cover washer, (38) float needle retaining spring, (39) float.

JIKOV
2922 SB 12 – 125 cc
2924 SB 14 – 175 cc
2926 SB 12 – 250 cc



Exploded view of Jikov SB models.

JIKOV
2922 SBD 11 – 125 cc
2924 SBD 17b – 175 cc
2926 SBD 15b – 250 cc



Exploded view of Jikov SBD models.

chamber top. By compressing the spring the throttle cable will be freed from the recess in the throttle valve and the spring resting on the needle clip can be removed. The needle clip secures the position of the needle.

The main jet, idling jet, throttle valve stop screw and the pilot air screw are accessible from the right-hand side of the carburetor after removal of the cover.

Access for cleaning and repairing the float chamber parts is obtained after unscrewing the two M 5 screws and removing the float chamber top.

Carburetors are adjusted at the works for breaking in. After approximately 1,500 to 2,000 km (1,000 miles) they have to be adjusted as follows:

For the 2922 SB 12 carburetor (for the 453 model):

main jet	105 (Solex)
idling jet	40 (Solex)
needle position	2nd to 3rd notch from top
pilot air screw	½ to 1 turn slack from tight

For the 2924 SB 14 carburetor (for the 450 model):

main jet	109 (Solex)
idling jet	40 (Solex)
needle position	2nd to 3rd notch from top
pilot air screw	½ to 1 turn slack from tight

For the 2926 SB 12 carburetor (for the 455 model):

main jet	120 (Solex)
idling jet	60 (Solex)
needle position	2nd to 3rd notch from top
pilot air screw	½ to 1 turn

More recently carburetor 2922 SBD II has been employed for the 453, 473, and 473.04 models:

main jet	85 (Solex)
idling jet	45 (Solex)
needle position	3rd to 2nd notch from top

Carburetor 2924 SBD 12 and later still 2924 SBD 17B carburetor for the 450, 470, and 474.04 models:

	2924 SBD 12	2924 SBD 17B
main jet	90 (Solex)	88 (Solex)
idling jet	45 (Solex)	50 (Solex)
needle position	3rd to 2nd notch from top	

Carburetor 2926 SBD 15B for the 455/05, 475, and 475.04 models:

main jet	92 (Solex)
idling jet	50 (Solex)
needle position	3rd to 2nd notch from top

(The pilot air screw setting is the same as for the SB carburetors.)

This adjustment applies to gasoline of 72 octane grade (regular). The adjustment has to be checked for other kinds of fuel.

When resetting the carburetor after running in, the throttle valve needle position has to be checked. After unscrewing the main jet bolt and the idling jet the value of the two jets has to be checked. The throttle valve stop screw should be slackened. The pilot air screw should be tightened and then slackened as prescribed. After starting, the engine idling speed has to be adjusted with the throttle valve stop screw. The throttle cable play has to be taken up with the cable bolt and its position secured with the nut.

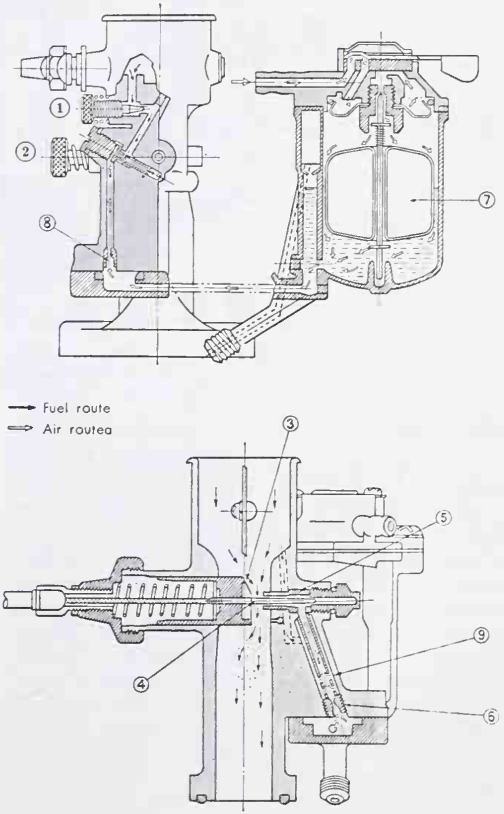
KEIHIN

Honda is the big user of Keihin carburetors made in Japan. Both the slide throttle and constant vacuum types are used. The slide throttle types are fitted to all models up to the 450, which has two carburetors.

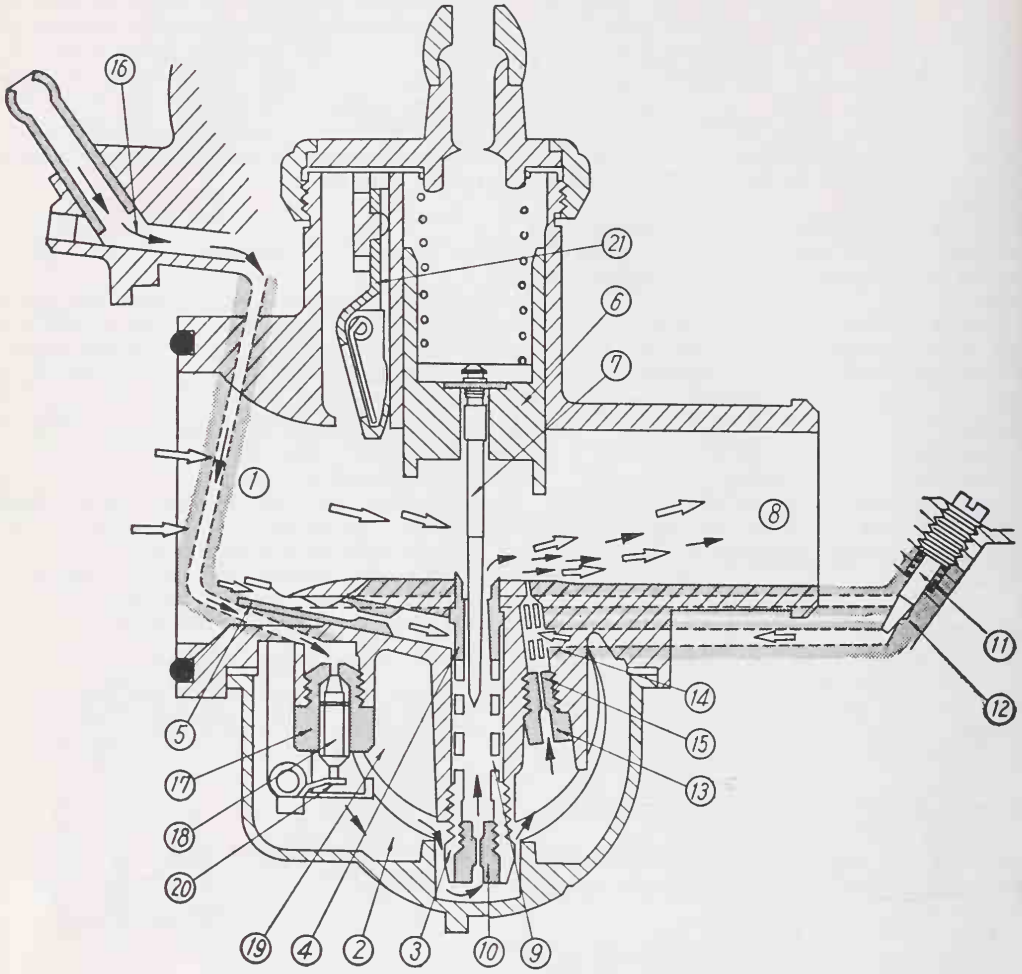
A downdraft model is found on the Honda 50 Model 100-102. Accompanying illustrations make the functions clear.

Adjusting screw (1) in pilot controls idling mixture. Turning to the right creates a richer mixture, to the left, a leaner mixture.

Screw (2) controls idle speed. Turning to the right increases speed, to the left reduces it. Idle speed should be 800–1,000 RPM.



Keihin downdraft type is used on Honda 100-102.



Fuel flow in Keihin sidedraft type.

Operation

When choke lever is pushed up to full shut position, the choke (2) comes down. The relief valve (3) usually acts to shut the window (5) by the spring (4). When the throttle valve (1) is opened about ¼, fuel sprays out from the pilot outlet (6) and the needle jet (7) (due to vacuum) and at the same time the relief valve (3) is opened (dotted part (8)) properly to allow air flow through the window (5) to give most adequate mixture for starting. After the engine is started, vacuum increases, opening the relief valve (3) widely to feed adequate mixture to the cool engine. The relief valve (3) opening will vary, corresponding to the throttle valve (1) opening (9).

Function of each part

① Main jet (10)

The primary function of the main jet is to control fuel flow for proper mixture at high speed.

② Air jet (5)

To prevent too rich a mixture at high speed (throttle wide open) or too lean a mixture at slow speed, air is supplied to the needle jet which controls the amount.

③ Needle jet (4)

At full throttle and at medium speed the needle jet once more works to control fuel after control by the main jet. It is adjusted at the same time as the jet needle.

④ Jet needle (7)

The function of the needle is to control mixture ratio at medium throttle opening (between ¼ and ½ turn) in conjunction with the needle jet explained above. The jet needle, having a

long taper, is fitted in a suspended state on the center hole of the throttle valve, the tapered end inserted in the needle jet. Therefore it moves up and down according to the throttle valve, its taper responsible for adequate mixture ratio. The needle can be adjusted to four positions, first position (highest) giving leanest mixture and fourth position giving richest mixture.

⑤ Throttle valve (6)

The throttle valve controls the amount of air suctioned by the engine and has the important function of controlling mixture. There is a cutaway on the air suction side of the throttle valve. By changing the size of this cutaway, negative pressure on the needle jet can be varied to change the amount of flow to change the mixture ratio. The range of this function is between idling and around ¼ turn, not effective above ½ turn.

⑥ Slow jet (13)

The slow jet controls flow of fuel at idling state. By a lower opening of the throttle a vaporized mixture is made by air coming through the orifice of the air bleed.

⑦ Air screw (11)

The air screw controls the amount of air flowing in the idle (slow) system. It controls air to be mixed with fuel which passes through the slow jet to get adequate mixture which is forced from the end of the slow jet.

In making preliminary adjustments, engine repair or replacing worn parts, be certain that

① each part of the engine is properly adjusted,
② the carburetor is checked for air leakage,
③ all worn parts are replaced with new parts.

High speed adjustment

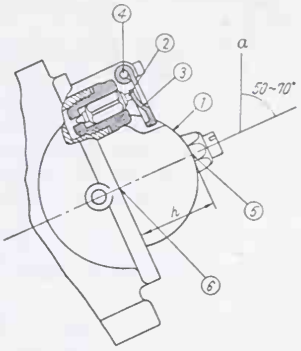
For the full throttle position (full to half open) adjustment is made in the main jet. To determine rich or lean mixture, the following procedure is used.

① While running at full throttle, close the choke a little; this creates a rich mixture. If the speed increases, replace the main jet with the next larger size and check again, using same procedure.

② If the speed decreases when closing the choke, the main jet is suitable, or too large. To determine if the jet is suitable or too large, replace jet with next smaller size. If the speed decreases and then speed increases by closing the choke, it indicates that the original jet is the proper one. Replace original jet for best performance.

Intermediate speed adjustment

For the throttle opening ⅛ to ½, the mixture is regulated by the height of the throttle cutaway and jet needle. Intermediate speed control is more precise since the cutaway will affect any speed under ⅛ throttle opening. Fuel consumption is most economical when the jet needle is leaned out to the left as much as possible without causing a loss in acceleration in the intermediate speed range.



Adjusting float level in Keihin.

① Jet needle

a. If black smoke comes out of the exhaust at intermediate speed, the mixture is too rich. Lean out the mixture by turning needle to the left.

b. If you feel the engine "braking" while accelerating or running at constant speed, turn jet needle to the right.

② Cutaway of throttle valve

The higher the punched mark, the weaker the mixture and vice versa.

Idle speed adjustment

From ⅛ throttle to idling, the mixture is regulated by the air screw and the throttle valve cutaway.

① Air screw

The mixture is regulated by the air screw while idling; a turn to the right makes the mixture richer; a turn to the left makes it leaner. After adjusting, check for engine misses by slightly opening the throttle. If there is a miss, re-adjust for better performance.

② Cutaway of throttle valve

At almost ⅛ throttle opening, mixture regulation is sometimes difficult. In such a case take higher cutaway number; if mixture is too rich and vice versa adjust the air screw again.

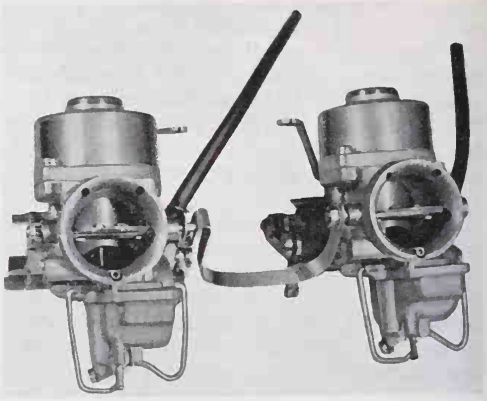
Adjustment of float position (carburetor removed from engine)

① Place the carburetor upside down. This is not the correct float position of the regular fuel level since the spring in the float valve is retracted due to the thrust from the float valve end on the float arm by the weight of the float itself.

② Tilt the carburetor so that the float pin (4) stays in upper position and float (1) in lower position; hold this position just before the float

arm (3) leaves the float valve end (2) (leaving point is about 70° from upside down position). Beyond a margin of 50° to 70°, the float valve (2) does not retract.

③ Measure the height difference between the lower end of the carburetor (5) and carburetor body (6). There is no difficulty with performance if the accuracy of the float position stays within 0.5 mm (.02") up and down. If deviated from this amount, adjust the float arm (3) by bending with special care to the prescribed 0.5 mm.



Constant velocity carburetors are used on Honda 450.

KEIHIN-HONDA 450

A pair of c/v (constant vacuum) carburetors of the Solex type are used on the Honda 450. With this c/v type, the throttle slide is not actuated directly by the cable, but by negative pressure above the piston which forms the slide. The venturi is thus changed according to demand and the primary/secondary venturi relationship becomes very smooth.

Venturi

The portion of the carburetor body where air enters and is squeezed by the throttle is called the venturi and in it the air flow rate becomes higher. This change in rate is accompanied by a change in pressure and if there is an opening in the side (or bottom) of the venturi section where fuel can be introduced, it will be sucked along by the airstream. To better vaporize the fuel droplets sucked up at this point, an air bleed is used.

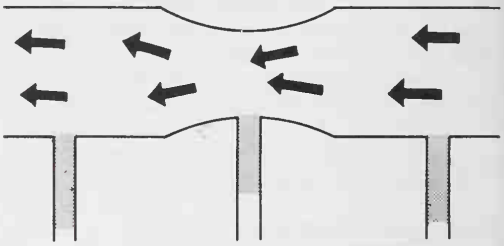


Illustration of pressure drop in restricted area of venturi.

Air bleed

Air bleed is graphically illustrated by the common soda straw. If you place a straw in your mouth and insert it into a glass of water and suck, you get a steady flow of water. If you remove your mouth from the end of the straw the water will flow back into the glass. If you make a hole in the straw, air mixes with the water and you get bubbles which show little tendency to return to the glass when you remove your mouth. If you could make an opening in the straw and introduce another straw so that the submerged junction of the "air bleed" and the "main jet" straws was under water, the bubbles in the "main jet" would be even smaller and more plentiful than previously. This is "air bleed."

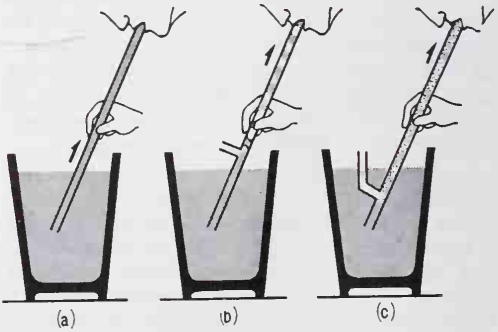
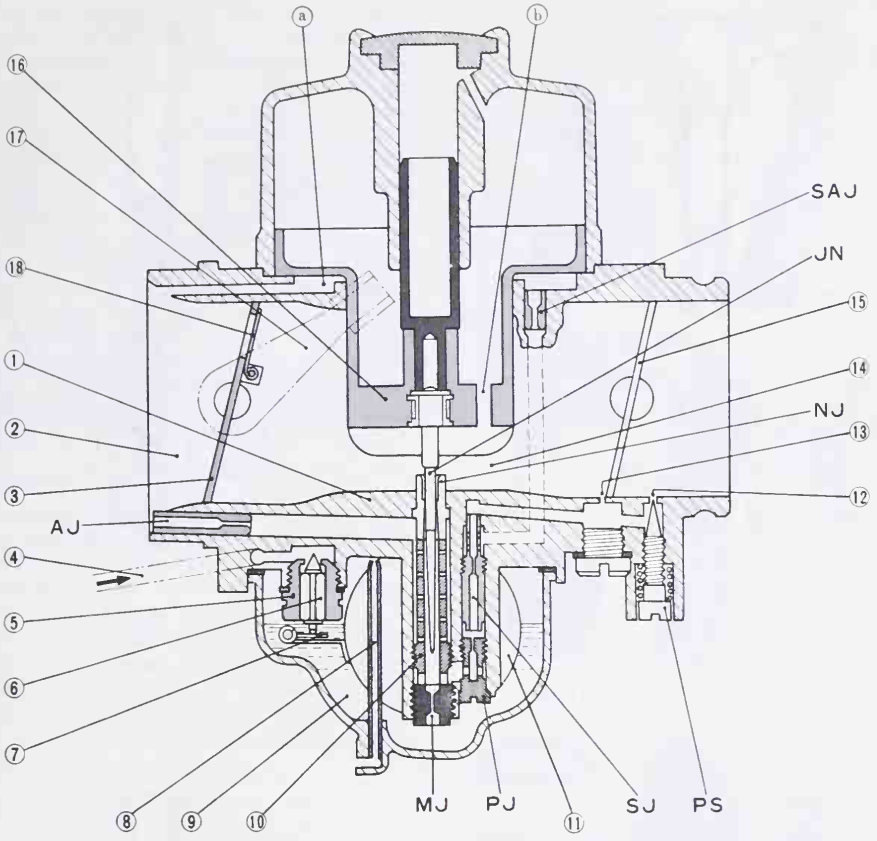


Illustration of air bleed principle.

① Air system

Air passed through the air cleaner is taken from the air intake (2) through (1) and (15).

When the amount of air required by the engine is small, the vacuum piston (16) is generally lowered and forms a primary venturi, thus maintaining the flow rate in the venturi.



Cutaway of Keihin constant velocity carburetor.

With an increase of air volume the flow rate in the narrow venturi portion (1) becomes faster than that of the air intake (2); thus the pressure of the venturi portion (1) becomes lower than that of the air intake (2) (i.e., becomes negative pressure). The difference in the pressure is transmitted as the pressure difference in between the upper and lower surfaces of the vacuum piston at portion (a) and portion (b) and the force to pull up the vacuum piston is actuated.

The vacuum piston (16) is pulled up in a value proportionate to the flow speed, and the venturi area is increased.

Further, as the engine reaches high speed, the vacuum piston rises up to the top and forms a secondary venturi sectional surface which is sufficient to maintain maximum output.

② Fuel system

a. Flow system

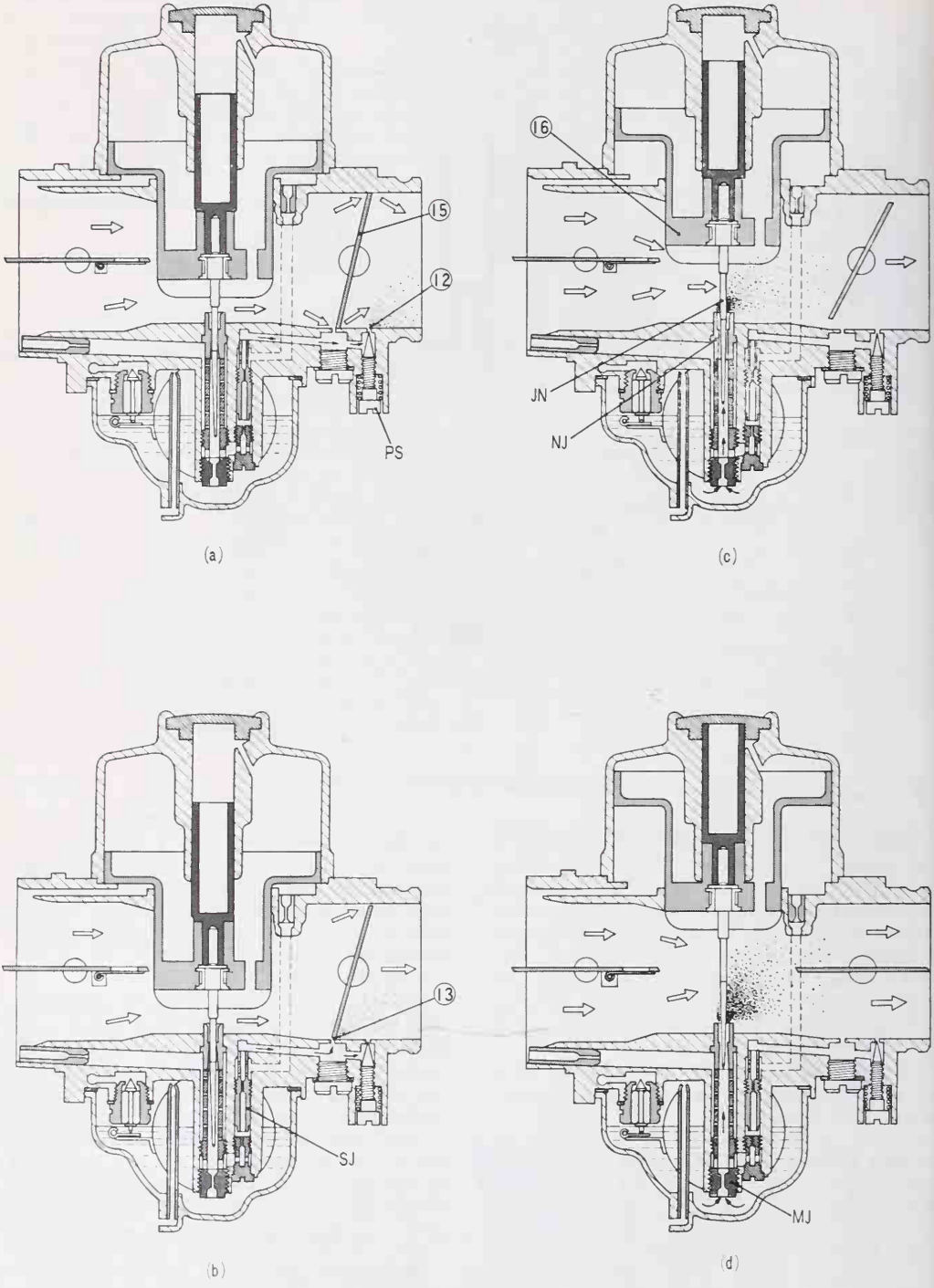
The amount of fuel which passes through the main jet is controlled at slow jet through the pilot jet. Simultaneously, the fuel is mixed with air from the slow air jet at the air bleed. The mixture jets from the pilot outlet (12) and bypass (13) near the periphery of the throttle valve. On the pilot outlet (12) the pilot screw which regulates the mixture is provided.

b. Main system

A part of the fuel which passes through the main jet is directed into the slow system as explained above. However, the other main portion of the fuel is mixed with air from the air jet within the air bleed of the needle jet holder, and jets out from the needle jet. When the vacuum piston is fully closed (when it works as the primary venturi) or when the vacuum piston is half closed, the tapered portion of the jet needle installed on the vacuum piston squeezes the fuel in order to prevent excessive fuel passage from the needle jet.

③ Float chamber

The fuel coming from the fuel tank enters the float chamber through passage from the fuel tank,



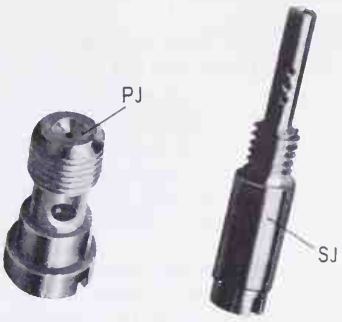
Fuel flow through C/V carburetor at various throttle openings.

float valve seat and float valve. The float (11) is floated up accordingly. The float valve (6) is lifted by the float arm (7), and when the float valve (6) contacts the float valve seat (5), the fuel inside the float chamber (9) is used, and the fuel lever is lowered. The float (11) is also lowered accordingly and the float valve (6) leaves the float valve seat (5); thus, the fuel enters into the float chamber (6). By repeating these operations, a constant fuel level can be maintained. The portion of the float valve (6) which contacts the float arm (7) is provided with a spring. Further, when the motorcycle is inclined or foreign matter sticks to the float valve seat, fuel overflows, and the fuel enters the cylinder; thus the overflow line (8) has been provided to maintain the specific fuel level. When the fuel level reaches a specific level, the overflow line permits the fuel to be discharged.

④ Choke

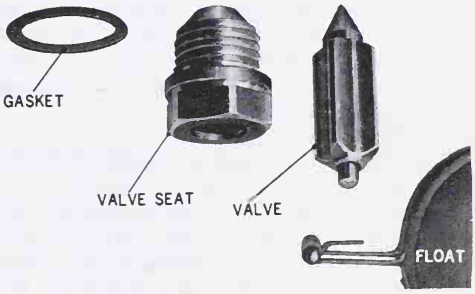
When starting engine in cold weather, it is necessary to provide a rich mixture and for this purpose a choke valve (3) has been provided. When the choke lever (17) is raised, the choke (3) closes and air flow is limited.

However, if the operation is improper, excess fuel is fed to the engine. For this reason, a relief valve (18) is provided on the choke valve (3). The relief valve (18) opens and closes by the negative pressure, and makes the mixture suitable to a cold engine.



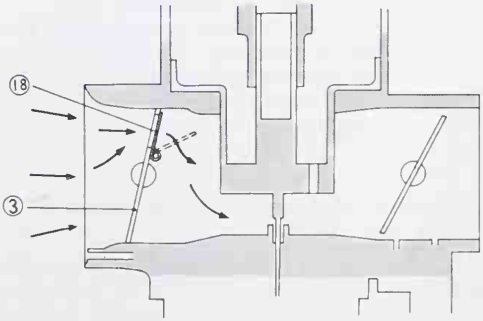
Pilot jet and slow jet of C/V carburetor.

Main jet, needle jet holder, and needle jet.



Float needle valve components in C/V model.

Vacuum piston and jet needle (JN) in Keihin C/V model.



Operation of relief valve in choke in C/V model.

Carburetor functions

① **Idling**

When idling, the throttle valve (15) is in an almost closed position, and the fuel is jetted from the pilot outlet (12). Accordingly, the mixture regulation is performed at the pilot screw. When the pilot screw is turned in, the mixture becomes lean and becomes rich when the screw is turned out. Screw the needle fully in and back off until the best engine speed is obtained with a closed throttle.

② **Low and cruising speeds**

The fuel is mainly jetted from the bypass (13) because the throttle valve (15) is opened at a specific level. Accordingly, the mixture adjustment is set by the inside diameter of the slow jet.

Note: The inside diameter is sometimes indicated by number, and for instance, if the number is #38, it means that the inside diameter is 0.38 mm.

③ **Medium speed**

The opening of the throttle valve (15) becomes larger, the vacuum piston (16) starts rising, and the fuel starts to jet from the needle jet; however, the jetting value is regulated by the jet needle. Accordingly, the mixture adjustment is performed by the setting position of the jet needle to the vacuum piston (16).

④ **High speed**

Both the throttle valve (15) and the vacuum piston (16) are fully opened, and accordingly, the jet needle's condition is that in which the jet needle is mostly lifted up; thus, the fuel is jetted out from the needle jet. The mixture adjustment is set at the main jet.

⑤ **Float level adjustment**

It is difficult to measure the height of the fuel level itself; thus, the fuel level is decided by the height of the float. Placing the carburetor vertically as shown and lightly lifting and lowering the float (11) by finger, determine the position where the float valve (6) head contacts slightly the float arm (7) or clearance of about 0.1 mm is left between them, and then measure "H" with a level gage. If "H" is not the rated value, adjust it by bending the float arm (7) carefully.

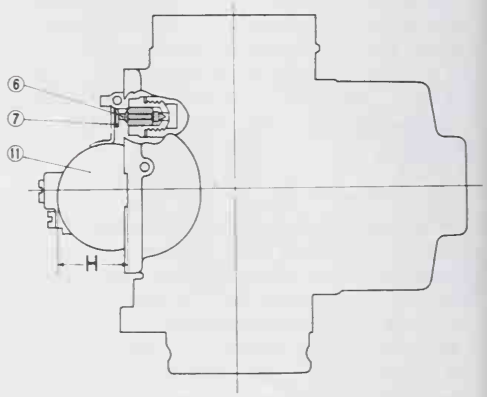
Note: When checking the contact of the float valve (6) and the float arm (7), it must be done very carefully, because the spring is contained in the float valve (6) and if this valve head is pushed, the spring is gone into the inside of the float valve.

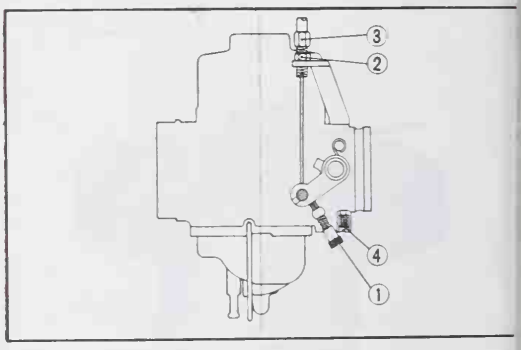
Carburetor cleaning and adjustment—Honda 450

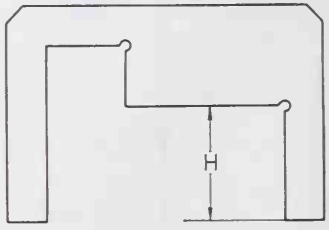
If the carburetor is contaminated or improperly adjusted, the engine efficiency is noticeably lowered. For example, if the mixture is too lean, the engine overheats, and if too rich, engine operation may become heavy and defective. When fuel overflows, it may cause fire. For these reasons, the carburetor must be disassembled, inspected, cleaned and adjusted periodically.

① Remove both left and right air cleaner case.

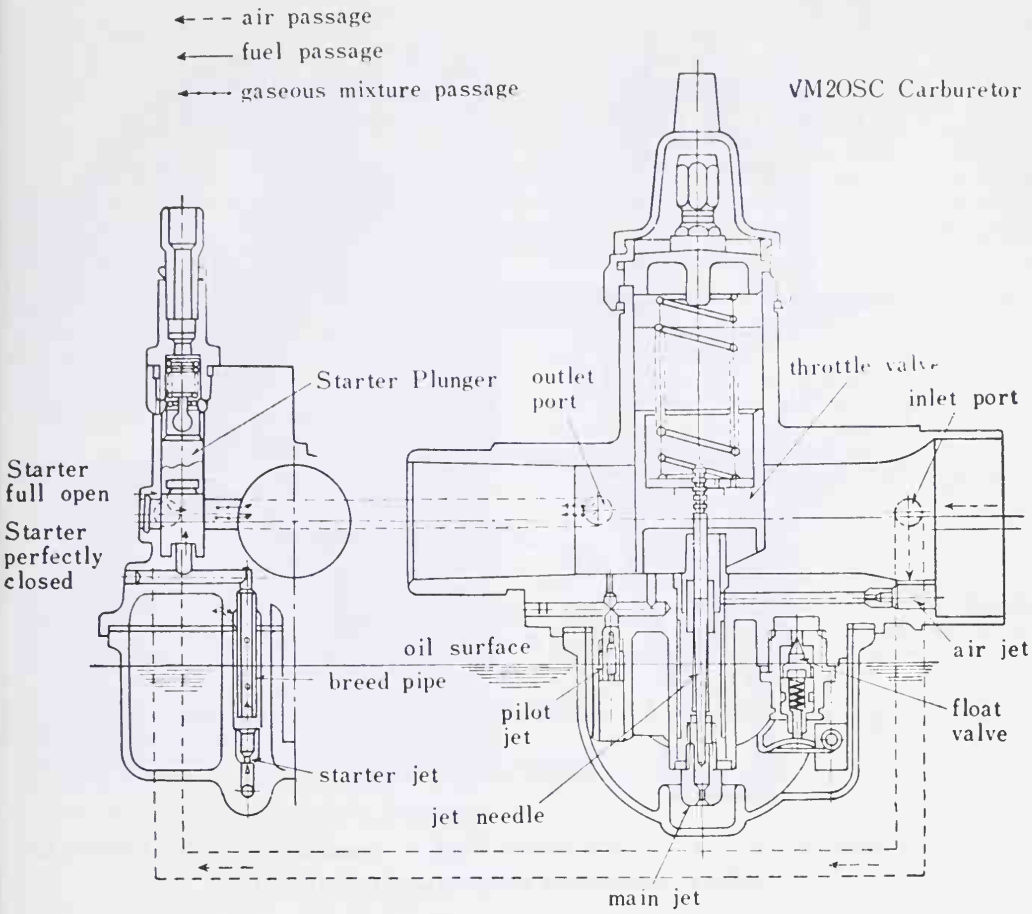
② Remove the 6 mm hex head bolt and air cleaner connecting the tube latch belt, take off the left and right air cleaner covers.







Float level gage for Keihin.



Schematic of carburetor used on Yamaha 250.

③ Loosen the throttle cable adjusting bolt and nut, remove the throttle wire from the carburetor.

④ Loosen the carburetor belt, remove the carburetors.

⑤ Disassemble and clean carburetors with gasoline.

⑥ Use compressed air to clean the individual nozzles, and after cleaning reassemble, reinstall, and adjust.

⑦ Idling adjustment

a. Turn the screw stop (1) to adjust so that both left and right exhausts are equal. When the stop screw (1) is returned, if the rotation cannot be lowered, loosen the lock nut (2), and tighten the cable adjuster (3) by one more turn.

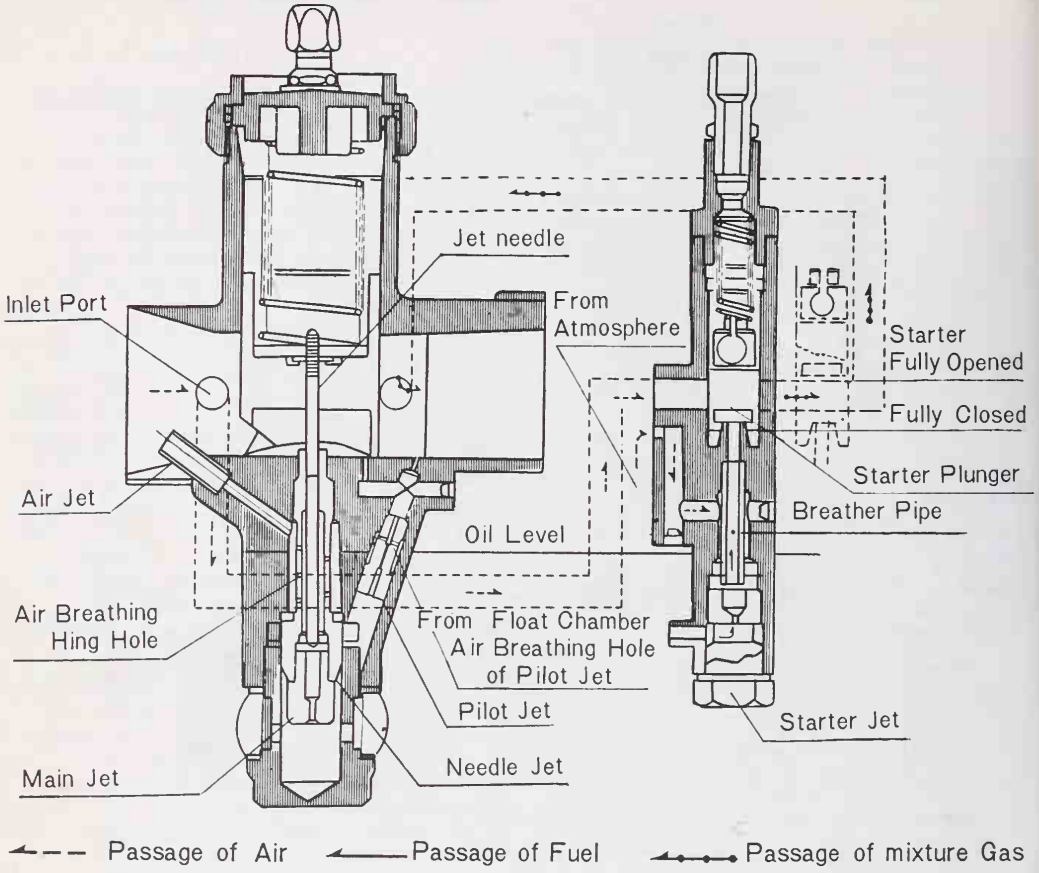
b. For either right or left, open or close the pilot screw (4) slowly from the present position and find the position where the engine speed becomes the highest. If tightened, the mixture becomes lean. If loosened, the mixture becomes rich. The adjusting should be performed within ± ⅛ to ¼ turn.

c. Readjust the difference of exhaust strength between the left and right which occurred with the adjustment performed in accordance with the instruction in (b) above, with the stop screw (1) in accordance with the instruction (a) above.

d. Repeating adjustments (a) through (c) above, adjust the carburetors so that the proper speed and exhaust strength are obtained from both left and right carburetors.

⑧ Throttle valve adjustment

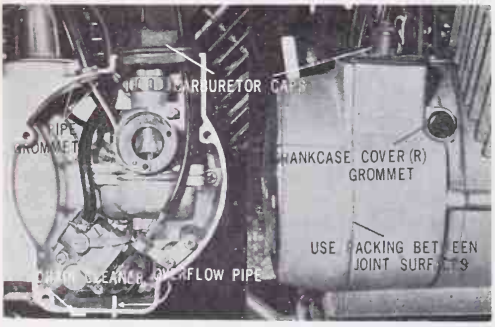
Adjust the throttle valve so that both side throttles operate equally. Touch both throttle arms with the fingers from beneath the carburetor and move the throttle grip a little to see if both levers start moving at the same time. If not, loosen the lock nut (2) and adjust with the cable adjuster (3).



Cutaway of Mikuni carburetor with starter on later model Yamaha.

MIKUNI

Mikuni carburetors are widely used on Japanese motorcycles, with Yamaha and Suzuki as the largest customers. The chief characteristic which distinguishes the Mikuni is an air vent pipe and an overflow pipe so that the engine will be less likely to fill with raw fuel in case of a stuck needle valve.



Mikuni used on Yamaha 125.

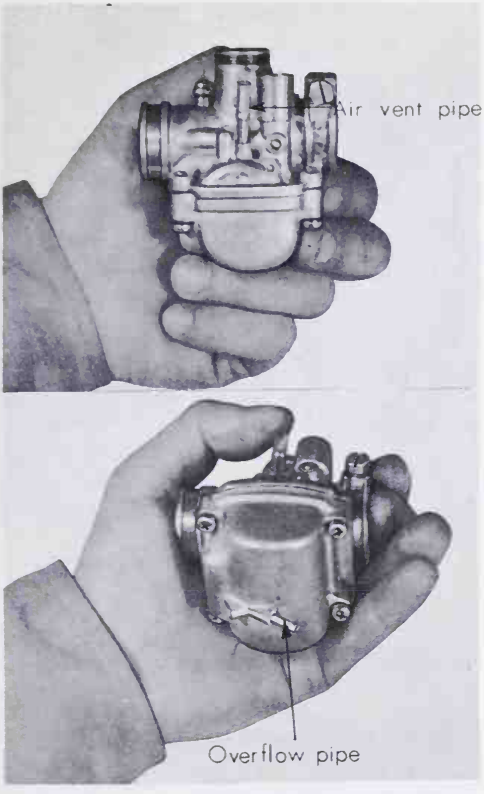
A typical Mikuni operation is as follows:

Main channel

Air reaches the carburetor through the air cleaner and air cleaner tube and is inducted into the engine from (1) through the throttle valve. This air flow creates a vacuum around the jet needle (2) and fuel in the float chamber is primed up through the main jet (3). Part of the air taken through the air jet (4) enters the needle jet (5) from five holes (6) located around the needle jet and creates bubbles in the fuel passing the needle jet. Air flows under the throttle valve at high speed so that bubbling fuel coming from the needle jet is atomized and mixed with the air.

Slow channel

When the engine is idling the throttle valve is lowered almost to the bottom, but air is taken through the air inlet (7) installed for engine idling. Air entering from the air inlet is metered by the pilot air adjusting screw (8) and primes up fuel through the pilot jet (9). A richer



Air vent and overflow pipe on Mikuni are safeguards for two-stroke engine.

fuel/air mixture than that mixed in the main channel is supplied through the outlet (10) to the engine. The fuel/air mixing ratio in the slow channel is controlled by the pilot air adjusting screw. To adjust, turn the pilot air adjusting screw to the bottom and then back the screw out 1.0 turn, which is the standard setting.

Starter device or choke

When the starter (choke) lever located on the handlebar toward the rider is activated, fuel will be primed up through the starter jet (11) by vacuum in the crankcase. The fuel will mix with air in the float chamber (13) which enters from the air bleed hole (12). The mixture jets from (14) and mixes again with air coming from (15), and the new mixture jets into the main bore through the hole located in front of the throttle valve. The mixture jets from the outlet in the main channel and enters the engine.

Disassembly

① Remove four fitting screws with a small Phillips screwdriver and separate the float chamber from the mixing chamber.

② The float can be removed from the mixing chamber body by removing the float pin.

③ Remove the main jet with a 6 mm wrench. Remove the needle jet with an 8 mm wrench. Remove the needle valve seat with an 8 mm wrench. Remove the pilot jet with a small screwdriver. Assembly is the reverse of the above sequence.

Adjusting idle

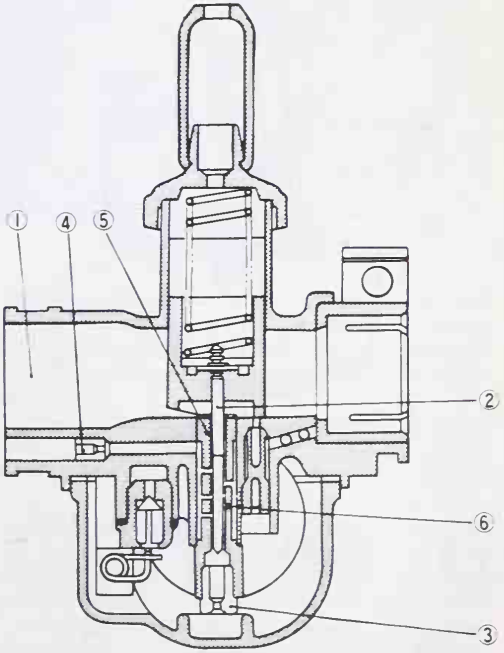
① Turn the throttle valve stop screw in so engine RPM increases.

② Turn the pilot air adjusting screw in so engine RPM decreases. Turn the screw in until the engine runs at the slowest speed.

③ After finding the lowest RPM, fix the screw a little before the lowest RPM. The engine RPM is still high at this stage.

④ Turn the throttle valve stop screw out and engine RPM decreases. Fix the screw at the spot just before the engine stops, which should be about 1,200 RPM. Measure with a revolution counter.

⑤ Turn the pilot air adjusting screw in and out within ¾ of a turn and find the position



Main channel of Mikuni.

where the engine runs most smoothly. The adjustment is finished.

Adjusting for various speeds

High speeds

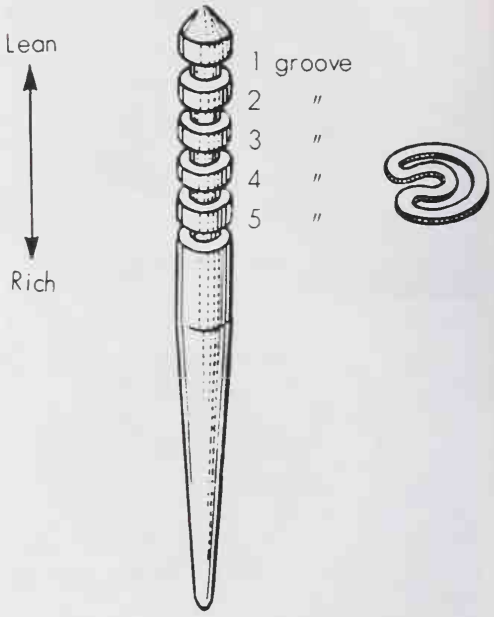
The mixture ratio is adjusted by the main jet at ¾ to full throttle openings. If the engine runs more smoothly when the throttle is turned back slightly from wide open it indicates the fuel mixture is lean. If engine RPM drops when the throttle is closed slightly it indicates the fuel mixture is lean. If engine RPM drops when the throttle is closed slightly it indicates that the fuel mixture is correct or too rich. Use a larger numbered main jet when the fuel mixture is too lean.

Medium speeds

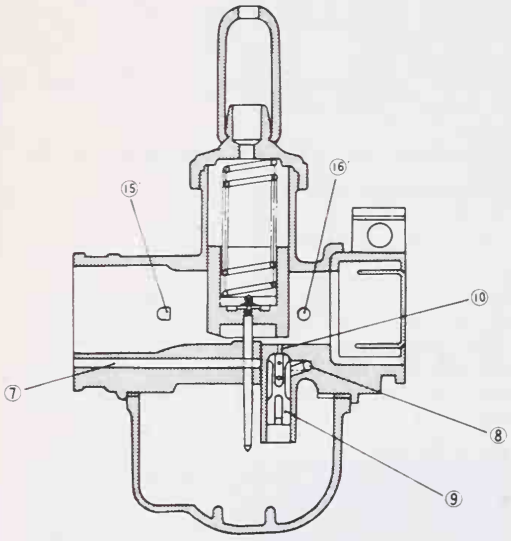
The mixture is controlled by the jet needle position and throttle valve cutaway at ¼ to ¾ throttle openings.

a. Adjusting with jet needle.

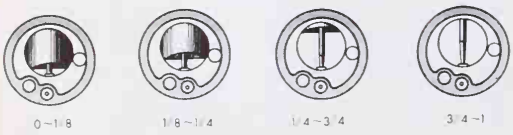
There are five grooves in the upper part of the jet needle, and they are counted from the top to the bottom: first, second, etc.



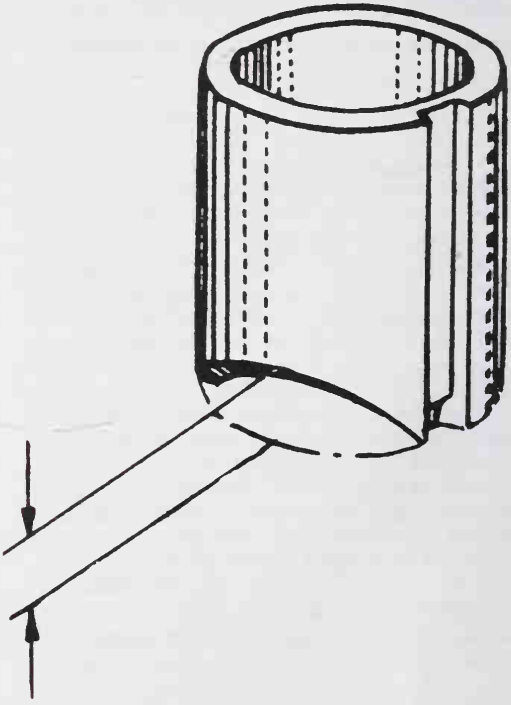
Typical jet needle and clip, Mikuni.



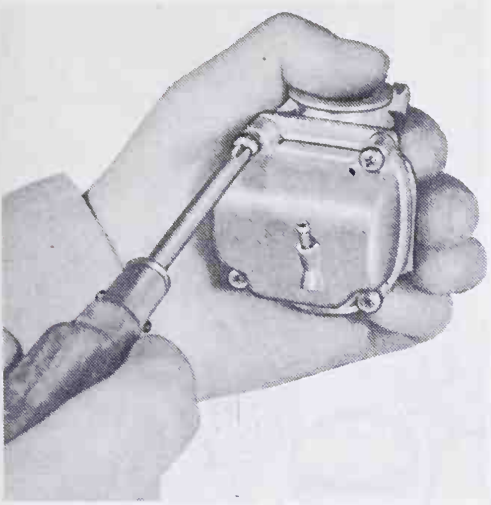
Slow channel of Mikuni.



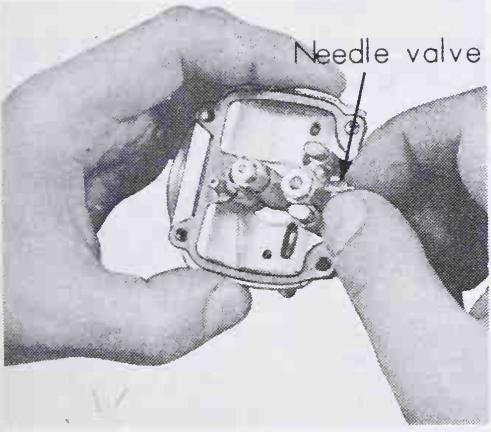
Throttle valve operation, Mikuni.



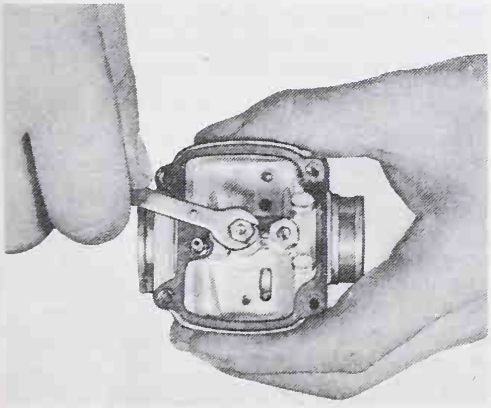
Throttle valve cutaway, Mikuni.



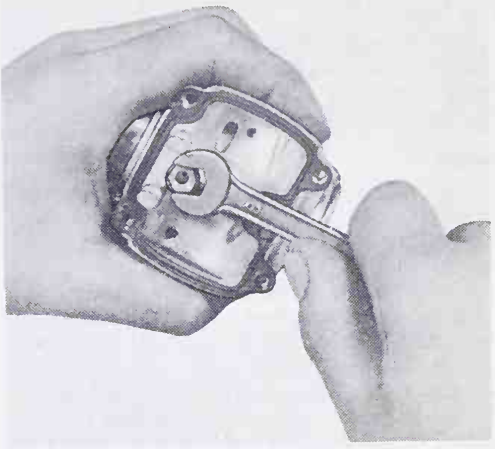
Removing bottom of float chamber, Mikuni.



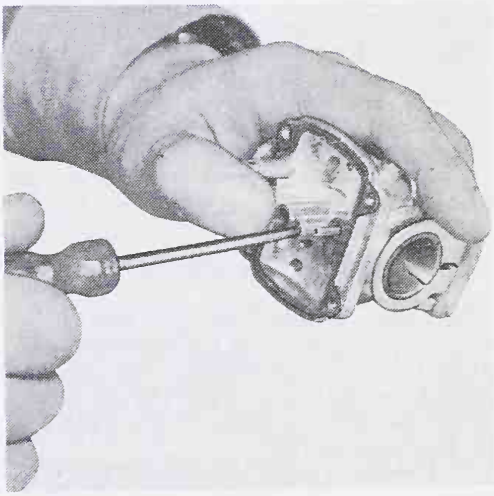
Removing needle valve, Mikuni.



Removing main jet, Mikuni.



Removing needle valve seat, Mikuni.



Removing pilot jet, Mikuni.

If exhaust fumes are white in color, it indicates the fuel mixture is too rich. Lower the jet needle by one groove; that is, fit the clip in the second gear from the top. Third groove is standard setting.

If engine RPM is not smooth while riding and it feels as if engine brake is being applied it indicates the fuel mixture is too lean. Raise the jet needle by one groove.

b. Adjusting with throttle valve cutaway.

A larger numbered cutaway increases air flow, giving a leaner mixture, and a smaller numbered cutaway decreases air flow, giving a richer mixture.

Adjusting by cutaway, however, affects engine performance at slow speeds below ¼ throttle opening. Do not change the throttle valve cutaway unless there is an urgent necessity.

Low speeds

Fuel mixture is adjusted by the pilot air adjusting screw and throttle valve stop screw at throttle openings between ⅛ and ¼ throttle openings. See adjusting idling section above.

Overflow

Fuel overflow is caused by a damaged float, imperfect contact of the needle valve and valve seat, worn needle valve, clogged carburetor fuel channel, etc.

As the needle valve repeatedly contacts the valve seat to keep the fuel level correct, the tip of the needle valve is apt to wear. If the needle valve is worn, there will be a gap between the valve seat and needle valve even when the float tongue pushes the needle valve. Fuel will flow into the carburetor continuously and overflow. Check to see if the needle valve contacts the valve seat properly when disassembling the carburetor. Replace the needle valve if needed. To check, remove the float chamber and push the float with a finger until the tongue pushes the needle valve. Turn on the fuel cock. If fuel flows into the carburetor, the needle valve is worn. Holes in the main jet, needle jet, etc., should be cleaned when the carburetor is disassembled. Clean these with compressed air. Do not use wire, etc., to clean the holes in these parts.

LINKERT/SCHEBLER

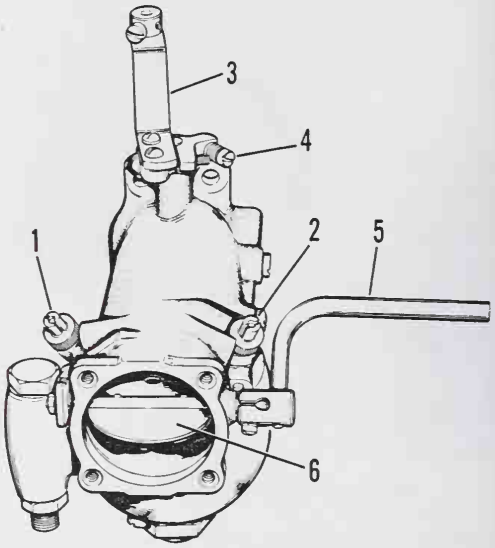
The Linkert/Schebler carburetors used for so many years on Indian and big Harley-Davidson models are simple and efficient. They are also easy to adjust and are designed to be adjusted on the road like tuning a motor scooter, which is a very productive method.

The Linkert is a side draft carburetor with fixed venturi and a throttle butterfly. There are adjustable low speed and high speed jets and an idling speed screw which changes the position of the butterfly on the type used on 61″ and 74″ models. The 55″ has a revised version which eliminates the low speed adjusting control knob and uses an idling mixture screw, and a throttle stop screw.

Adjustment (61″, 74″)

If you are starting with an engine which runs satisfactorily but not as well as it might, and carburetion seems to be the problem, fire it up and bring it to operating temperature. Then set the throttle stop (idling speed screw), to achieve about 850–900 RPM. Spark control should be retarded.

Screw the low-speed needle in until the engine stumbles and almost dies. Then turn the adjuster out ¼ turn. Reset the throttle stop screw to desired idling speed.



Harley-Davidson carburetor. (1) High speed needle, (2) low speed needle, (3) throttle lever, (4) throttle stop screw, (5) choke lever, (6) choke disc.

The high speed adjustment should be carried out with the engine under load, but it can be made on the stand where the engine's ability to respond to sudden increase in throttle opening is the test.

Set the spark to advanced position and blip the throttle, opening it up suddenly, accelerating to high speed and closing it abruptly. Screw the high-speed jet needle in until the engine hesitates and dies or backfires. Then screw the control out gradually, blipping the throttle until the condition clears up. This is ordinarily about ¼ turn, but in old carburetors it could be anything.

After adjusting the high-speed jet, it will probably be necessary to reset the idle to desired speed.

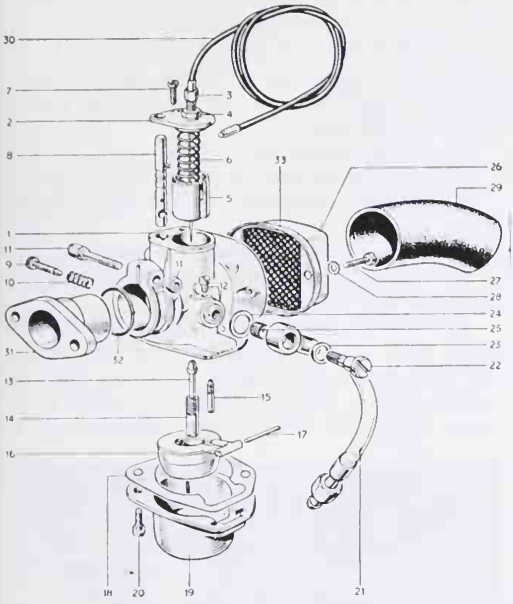
On-the-road adjustment is made by turning the high-speed needle control back and forth until the best acceleration characteristics from about 30 mph up to 50 mph are found.

Adjustment (55″)

The same general idea is used for the 55″ model, but start by screwing in both the idling screw and the high-speed needle adjustment fully home and backing off 1½ turns. Fire up the engine and get it to operating temperature, with choke open.

Set the idling speed at a moderately fast idle. Screw the idling adjustment in until the engine falters, then back it off enough to make the engine run smoothly.

The high-speed jet is turned in gradually while suddenly accelerating the engine from idle to high speed. When it begins to stumble and backfire,



Zenith carburetor. (1) Carburetor body, (2) mixing chamber top, (3) cable adjuster, (4) adjuster locknut, (5) throttle slide, (6) slide spring, (7) top to body screw, (8) starter slide, (9) throttle stop screw, (10) stop screw spring, (11) clamp nut and bolt, (12) plug screw, (13) emulsion tube, (14) main jet, (15) slow running jet, (16) float, (17) float hinge pin, (18) joint washer, (19) float bowl, (20) float bowl screw, (21) feed pipe, (22) union bolt, (23) fiber washer, (24) fiber washer, (25) filter gauze, (26) intake adaptor, (27) adaptor screw, (28) shakeproof washer, (29) rubber connection, (30) throttle cable, (31) adaptor to head, (32) "O"-ring, (33) air filter.

turn the needle back out just enough to enable the engine to "take it." You can check this on the road by accelerating from 30 to 50 mph.

The big problem with many of these carburetors is warpage of the flange caused by improper bolt tightening in the hands of past owners or mechanics. Air leakage is the result and all the twiddling in the world won't bring them into adjustment. Check with an oil can filled with gasoline, i.e., squirt fuel at the flange base with the engine idling. If the engine speeds up, you've got an air leak.

Overhauling

Disassembling and cleaning of any of these carburetors follows an obvious pattern, with attention to be paid to the following points on reassembly:

① Be sure the venturi is installed properly with the main jet well (spray nozzle) projecting into it, and the small spring placed under it.

② The stepped washer below the low speed needle spring is critical. If left out, too much air can be vented past the needle and the mixture will be too lean and make low speed difficult to adjust.

③ Float level is approximately ¼" from top of float to top of bowl. Bend the float lever carefully between the float and the fulcrum pin, preferably with the float removed from the bowl to avoid bending the small prongs which contact the needle head.

ZENITH

Zenith MX carburetors are used on some Triumph models. This is a slide-throttle type. The accompanying illustration will make the disposition of parts clear.

There is no float tickler, but pressing down the plunger (8) to the limit of its travel will provide a rich mixture for starting when cold. The metering hole in the plunger mates with an air passage in the body and fuel is drawn through the slow-running jet (15). After a short time (30 seconds or so) open the throttle to the full extent to return the plunger to its normal position.

TUNING

If the truth were known, most motorcycle engine troubles stem from inept tuning. Because the cycle engine is so simple in format and so accessible, nearly every rider, at one time or another, undertakes to "tune it up."

This isn't bad, in fact it is commendatory. But too few of them attempt to find out anything about the process before they begin. No good mechanic ever picks up a screwdriver in anger unless he has access to the right information about the machine he is approaching. Amateurs should be as conscientious.

Tuning consists of adjusting the variables so that they meet factory specifications, as far as street bikes are concerned. Racing is another matter, which doesn't concern us here.

The four-stroke variables are (1) valve timing, (2) valve clearance, (3) fuel/air ratio, (4) spark timing, (5) point and plug gap.

Two-stroke mechanics have even less to worry about: carburetion, spark timing, points, and plug.

So tuning is no big deal, if you go at it logically.

① Set the valve/tappet (rocker arm, lifter, etc.) clearance. This is specified with engine cold in almost all cases. "Cold" simply means that the engine should be approximately the same temperature as the rest of the bike, the frame, etc. In other words, don't adjust the valves if the engine, or the oil in the engine, is warmer to the touch than any other part.

Letting it sit overnight is the rule followed by most shops, but whatever time it takes to cool down is the amount to allow. Clearances specified with engine warm are marked with an asterisk (*).

The best way to gage the clearance is by go and no-go. If clearance is specified as .008", don't check it with a .008" feeler gage. Use a .007", which should slide through the space, and a .009" which should not. The most important thing is to be sure you have the tappet, pushrod, rocker arm (or whatever is applicable to the type of valve train in your machine) on the heel of the cam, and not slightly onto the quietening ramp or the lobe itself. This means that you should have the piston at top dead center on the compression stroke, not the exhaust stroke. At this point you can set both inlet and exhaust valve clearance.

This does not hold true with the Triumph twins and Matchless singles, however. On the Triumphs, set clearance on the intake valve of one cylinder when the intake valve on the other cylinder is fully open, then repeat with the exhaust valves in the same manner. On the Matchless, rotate the engine until the piston is at TDC on compression/ignition. Turn the engine back until play is just taken out of intake pushrod and set exhaust valve clearance. Then turn the engine forward until past TDC and play is taken out of exhaust pushrod and set intake valve clearance.

② Adjust the point gap. Use a pair of feeler gages in the same way as for the valves. Points are on spring tension and they can easily be forced open with the gage.

③ Set the ignition static timing.

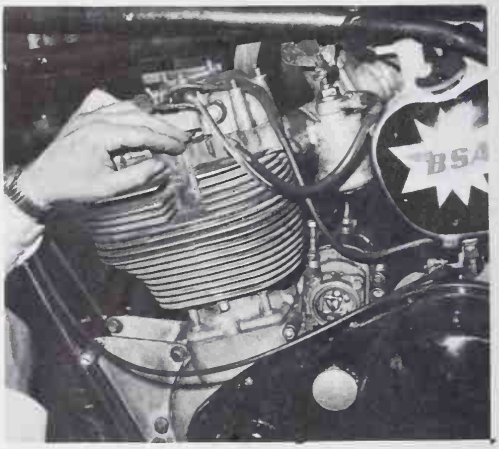
④ Re-check the point gap, just to be sure.

⑤ Check the automatic advance with a timing light.

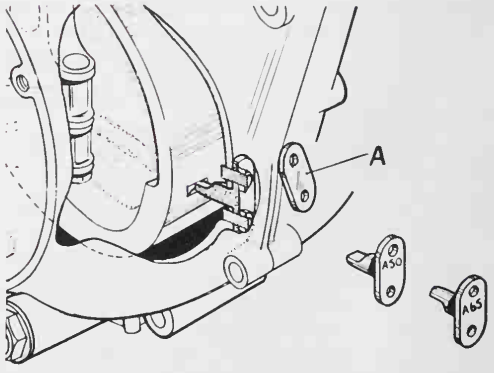
⑥ Clean, adjust, or replace the spark plug.

⑦ Make sure the throttle is opening fully when the twist grip is wide open.

⑧ Start the engine, warm it up, adjust the idle speed screw to give a moderately fast idle. Screw the pilot needle (slow speed screw) in until the engine starts to stumble and back it off ⅛ to ¼ turn. Twist the throttle open abruptly. If it



Establishing top dead center with steel ruler.



Later BSA models have crankcase plug to define limit of automatic advance.

ARIEL

MODEL	PLUGS	POINTS	TAPPETS Int.	TAPPETS Exh.
50-75cc Pixie	.020	.012	.003	.003
200cc Colt	.020	.014	.010	.012
250cc Arrow & Leader	.030	.015	—	—
350-500cc singles	.015-.018	.012	.006	.008
500cc twin motor	.015-.018	.012	.005	.008
650cc twin	.015-.018	.012	.010	.010
1000cc 1949-'52	.018-.020	.015	.001	.001
1000cc 4-Port 1953-'59	.018-.020	.015	.006	.008

BMW

MODEL	PLUGS	POINTS	TAPPETS Int.	TAPPETS Exh.
R 50	.024	.016	.006	.008
R 50S	.024	.016	.006	.008
R 60	.024	.016	.006	.008
R 69S	.024	.016	.006	.008

BSA

MODEL	PLUGS	POINTS	TAPPETS Int.	TAPPETS Exh.
75cc Beagle Starlite	.020	.012	.003	.003
125-150-175cc Bantam	.020	.015		
250cc C11, C12 1947-'48	.020	.014	.012	.012
250cc C15 1959-'64	.020	.015	.008	.008
350cc B31	.020	.012	.003	.003
500cc B33	.020	.012	.003	.003
500cc B34GS	.020	.012	.006	.006
500cc A7 1951-'62	.020	.012	.008	.010
500cc A50 twin 1962-'64	.025	.015	.008	.010
650cc A10	.020	.012	.008	.010
650cc A10R	.020	.012	.008	.010
650cc A65	.025	.015	.008	.010
650cc A65R	.025	.015	.008	.010
500cc A501R	.023	.015	.008	.010
500cc A502W	.023	.015	.008	.010
650cc A652H	.023	.015	.008	.010
650cc A652L	.023	.015	.008	.010
650cc A651T	.023	.015	.008	.010
650cc A65SP	.023	.015	.008	.010
441cc Enduro	.023	.015	.008	.010

HARLEY-DAVIDSON

MODEL	PLUGS	POINTS	TAPPETS Int.	TAPPETS Exh.
'55 XLCH	.025	.022	.001	.002
74 S.V.	.025	.022	.005	.007
61-74 ovh 1936-'47	.025	.022	.001	.002
74 ovh 1948-'64	.025	.022	Hydraulic	
125-165-175	.020	.015		

Greeves

MODEL	PLUGS	POINTS
24 MX2 250cc	.026	.016
TE 250cc Trials	.026	.016
TES 250cc Trials	.026	.016
24 RDS	.026	.016
250cc Sports Circuit Racer	.026	.016

Kawasaki

MODEL	PLUGS	POINTS
85-J1I	.026	.015
85-J1TRI	.026	.015
100-D1	.024	.015
125-B8T	.026	.015
175-F1	.026	.015
175-F2	.026	.015
250-A1	.026	.015

Honda

MODEL	PLUGS	POINTS	TAPPETS	
			Int.	Exh.
50-55cc (All)	.026	.014	.004	.004
90-S90	.026	.014	.002	.004
125cc mod. C92	.026	.014	.004	.004
150cc mod. C95	.026	.014	.004	.004
125cc mod. CB125	.026	.014	.004	.006
160cc mod. CB160	.026	.014	.004	.006
250cc mod. CB72	.026	.014	.004	.004
300cc mod. CB77	.026	.014	.004	.004
450cc mod. CB450	.026	.014	.012	.012

Indian

MODEL	PLUGS	POINTS	TAPPETS	
			Int.	Exh.
500cc 30.5"	.020	.015	.005	.008
750cc 45"	.020	.015	.005	.008
1200-1300cc 74" & 80"	.020	.015	.005	.008
250cc Brave	.025	.018	.003	.004
438cc twin	.025	.015	.003	.003
220cc single	.025	.015	.003	.003
500cc twin ovc	.025	.025	.003	.003

Matchless & A.J.S.

MODEL	PLUGS	POINTS	TAPPETS	
			Int.	Exh.
250cc	.020	.012	Nil*	Nil*
350cc	.020	.012	Nil*	Nil*
500cc	.020	.012	Nil*	Nil*
500cc "CS"	.020	.012	.006	.006
600cc "TCS"	.020	.012	.006	.006
500cc twin	.020	.012	.006	.006
600cc twin	.020	.012	.006	.006
650cc twin	.020	.012	.006	.006

Norton

MODEL	PLUGS	POINTS	TAPPETS	
			Int.	Exh.
400cc	.020	.012	Nil	Nil
500cc	.020	.012	.004	.006
600cc twin	.020	.015	.002	.005
650cc twin	.020	.015	.002	.005
750cc twin	.020	.015	.006	.008
500cc twin	.020	.012	.002	.005

Panther

MODEL	PLUGS	POINTS	TAPPETS Int.	TAPPETS Exh.
250cc	.020	.014	Nil	Nil
350cc	.020	.014	Nil	Nil
600cc	.020		Nil*	Nil*
650cc	.020		Nil*	Nil*

Royal Enfield

MODEL	PLUGS	POINTS	TAPPETS (Aluminum Head) Int.	TAPPETS (Aluminum Head) Exh.
250cc Crusader	.020	.015	.002	.004
350cc Bullet	.020	.015	Nil	Nil
500cc Bullet	.020	.015	Nil	Nil
700 & 750cc twin	.020	.015	Nil	Nil
750 Interceptor	.020	.015	.003	.005

Sunbeam

MODEL	PLUGS	POINTS	TAPPETS Int.	TAPPETS Exh.
500cc S7 S8	.020	.012	.018	.018

Triumph

MODEL	PLUGS	POINTS	TAPPETS Int.	TAPPETS Exh.
Standard T20	.020	.015	.010	.010
Sports T20S & T20SH	.020	.015	.002	.004
350cc 3T	.020	.012	.001	.002
500cc 5T	.020	.012	.001	.002
500cc T100, Tiger 100	.020	.012	.002	.004
650cc 6T, T'bird, Tiger 110	.020	.012	.010	.010
350cc 3TA Twenty-one	.020	.015	.010	.010
500cc 5TA Speed twin	.020	.015	.010	.010
500cc T100A Tiger 100	.020	.015	.002	.004
500cc T100SS Tiger 100	.020	.015	.002	.004
650cc T'bird 6T 1955-'62	.020	.015	.002	.004
TR6 Trophy 1955-'62	.020	.015	.002	.004
T100 Tiger 110 1955-'62	.020	.015	.002	.004
T120 Bonneville 1955-'62	.020	.015	.002	.004
6T Thunderbird 1963-'64	.020	.015	.002	.004
TR6 Trophy 1963-'64	.020	.015	.002	.004
T120 Bonneville 1963-'64	.020	.015	.002	.004

Velocette

MODEL	PLUGS	POINTS	TAPPETS Int.	TAPPETS Exh.
200cc twin LE	.020	.012	.004	.006
350cc ovc	.020	.012	.005	.005
500cc ovc	.020	.012	.005	.005

MONTESA

MODEL	PLUGS	POINTS
175cc Impala Sport	.012	.016
175cc Enduro	.012	.016
175-250cc Impala Cross	.012	.014
250cc Scorpion	.012	.012

VILLIERS

MODEL	PLUGS	POINTS
98cc 1, 2, 4, & 6F	.025	.015
125cc 10D & 12F	.025	.015
150cc 31C	.025	.015
200cc 6E, 8E, & 9E	.025	.015
250cc	.025	.015

SUZUKI

MODEL	PLUGS	POINTS
All models	.024	.014

VINCENT

MODEL	PLUGS	POINTS
1000cc Rapide	.018	.012
1000cc Black Shadow	.018	.012

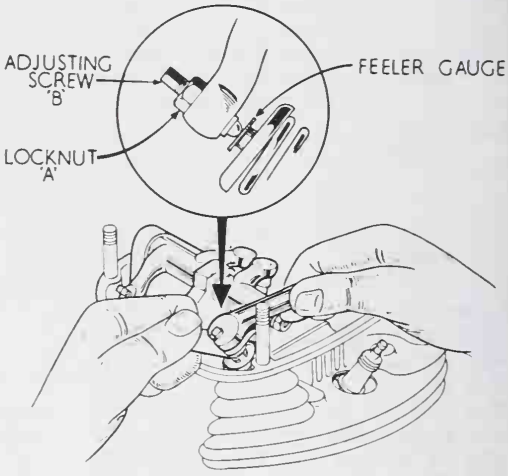
YAMAHA

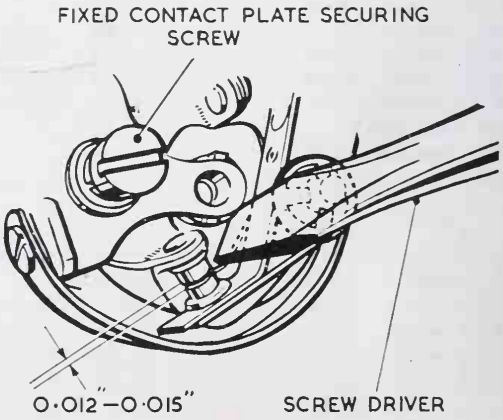
MODEL	PLUGS	POINTS
All models	.024	.014

stumbles, richen the mixture slightly. Then re-set idle speed as you prefer it. This should make the bike run as well as its condition will allow.

To go any farther than this, check the appropriate heading in the carburetor chapter for the finer points of individual carburetor tuning.

If you have a two-stroke, ignore the valve timing bit and proceed (2) through (8).





Chapter 6

Frame and Running Gear

Troubles associated with the frame and running gear generally show up as excessive tire wear, poor steering, inferior braking, or bottoming of the suspension. Also to be included under this general heading would be the effects of too much or too little chain tension.

Abnormal tire wear

Improper inflation is the principal curse of tires; overloading is the second offender.

If you do not have the owner's manual for the cycle (or in case the owner's manual fails to supply the information because some Japanese printer left the information out) here is a rule of thumb guide to *minimum* inflation.

Tire size	Front	Rear
2.25	22	28
2.50	20	26
2.75	16	22
3.00	17	22
3.25	17	21
3.50 & up	15	16

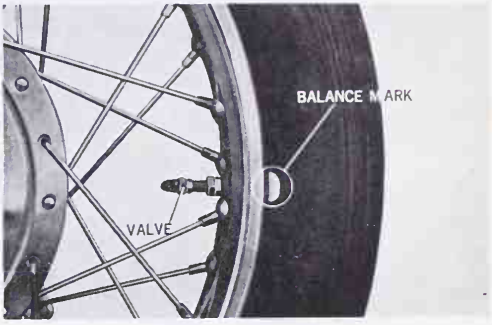
These standards would be for the lightest bike and lightest rider. As you add weight you must increase pressure. Generally the lightest bike to be fitted with each size tire goes something like this:

Size	Weight
2.25	150
2.50	175
2.75	225
3.00	275
3.25	325
3.50	350

For every 25 pounds of *unladen* weight over these standards, add a pound of air to front and rear. For every 25 pounds *you* weigh over 150, add a pound, front and rear. If you are going to carry a passenger, add about 5 pounds to the rear and a couple to the front. For sustained high speed riding, higher pressures than normal are required.

This will prevent you from ruining tires by under-inflation and will assure fairly decent handling. To get exactly the right combination for your cycle is a matter of trial and error, however.

The symptoms of under-inflation are excess tire wear at the sides of the tread (plus, of course, mushy steering, poor handling, etc.).



Balance mark on tire should be adjacent to valve stem.

Over-inflation results in excess wear in the center of the tread, hard, jolting riding, etc.

Misalignment will also cause tire wear. Check the alignment of the wheels with a long straightedge, particularly if the chain has been replaced or the rear wheel removed for any reason.

Wheel-trueing

Loose or bent spokes can pull a rim out of true and lots of riders whip out the old spoke wrench and go to work. You can do it, but the best advice is to take the wheel to somebody who has plenty of experience. Each spoke must be tightened or loosened a fraction of a turn at a time and it is a time-consuming process. The tyro is apt to pull the wheel out of round while trying to cure lateral deflection.

Heavy or stiff steering

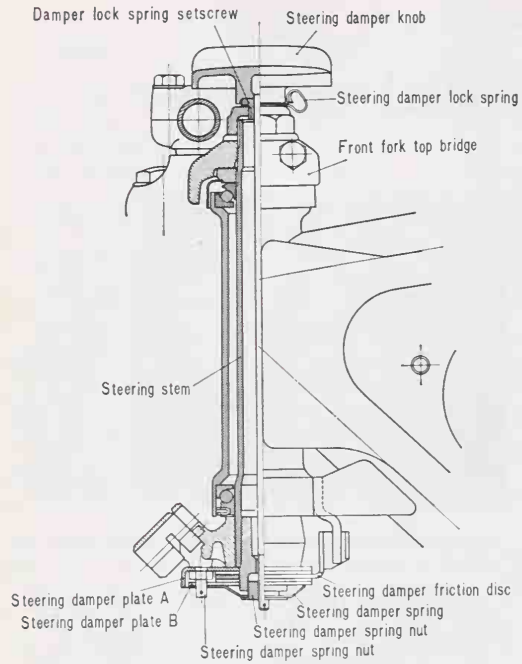
In addition to low front tire pressure, which seems pretty obvious, heavy steering can be traced to bad steering head bearings or incorrect adjustment of the control.

Uncertain or wobbly steering

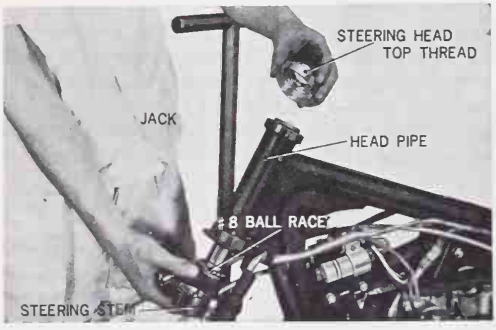
Worn bearings in the steering head or in the front wheel are the first choices in this case. In the case of non-adjustable bearings, replacement is the natural course. Another possibility is that the tire is not properly seated on the rim, not running true. This latter condition will show up as handlebar oscillation at slow speed.

Bottoming of suspension

In the high mileage bike this can be due to fatigued springs, but more than likely it is caused



Steering damper cutaway, Honda 450, typical of other models.

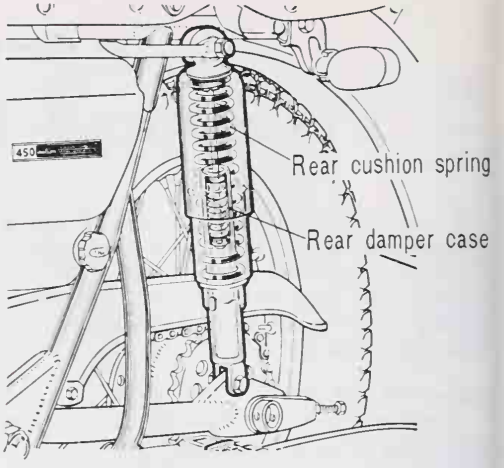


Removing steering stem, downward, Honda.

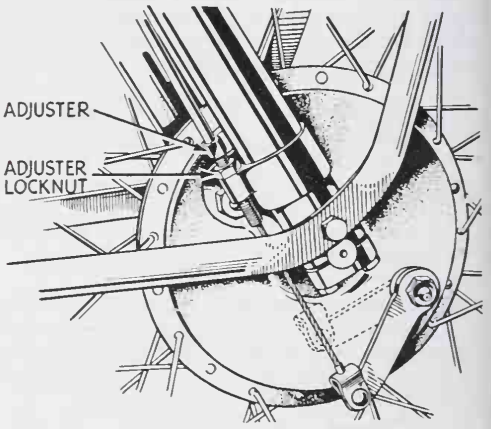
by lack of oil in the front forks and/or failure of the shock unit in the rear.

The oil in front forks should be replaced at 10,000 miles or seasonally. If this is not done, gumming and deterioration of the oil can result in poor action. Rear cushion units should be replaced as a unit.

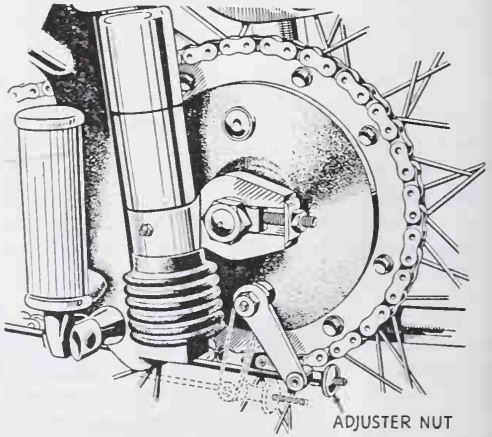
Although "Spindle Oil" is the term used by many factories in describing the oil to be used in forks, any good lubricating oil can be used. SAE 30 is generally the grade in summer or in climates where winter temperature doesn't drop below 56° in the daytime. In the winter in rough climates,



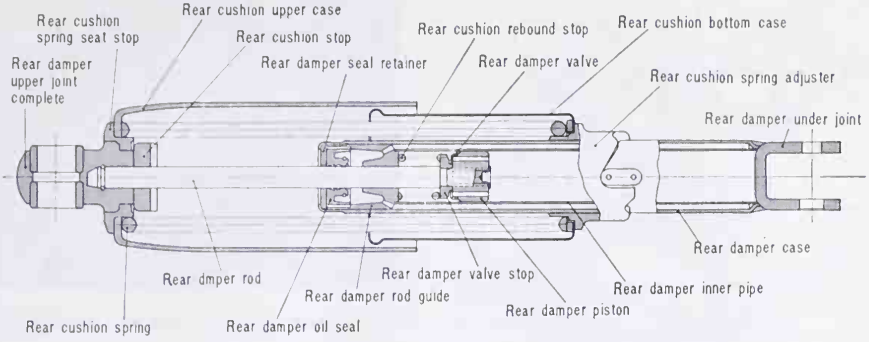
Installation of rear cushion, typical.



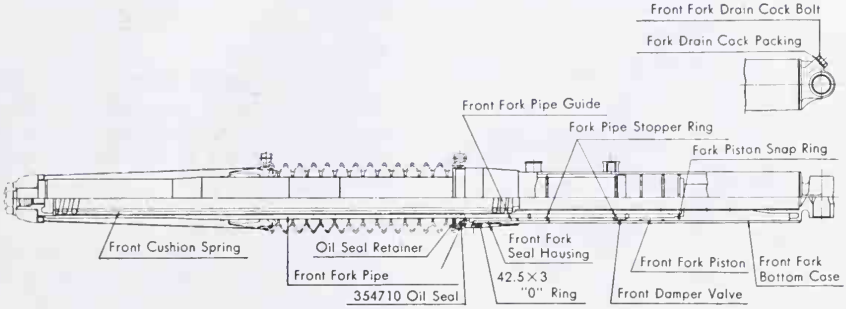
Front brake adjustment, Triumph. The dotted line drawing indicates position of the brake lever when linings are badly worn.



Rear brake adjustment, Triumph. Dotted line drawing of lever shows position when linings are worn.



Cross section of rear cushion assembly, Honda 450, typical of other models.



Front fork cushion, Honda 450, typical of other models.

SAE 10 can be substituted. For some riders year-round 20 weight is satisfactory. It doesn't cost much to experiment and the handling of the bike can be tailored a great deal to your liking by changing the oil. Some mechanics suggest the use of non-detergent, or low detergent such as Valvoline.

Dragging brakes

Externally, lack of free play in the brake pedal or hand lever will cause dragging brakes. Internally, weak return springs or rusted cam and lever shafts can prevent full retraction. The symptoms may not be so severe as to include poor performance, yet there can be enough drag to cause excessive brake lining wear. The obvious symptom is hot wheel hubs.

Scraping sound from brakes

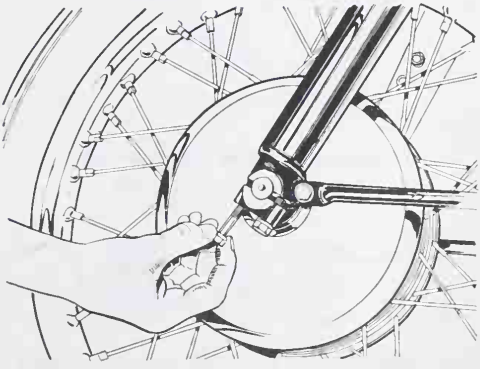
This is due to worn-out brake linings, a broken shoe, or broken pivot.

Lining replacement time

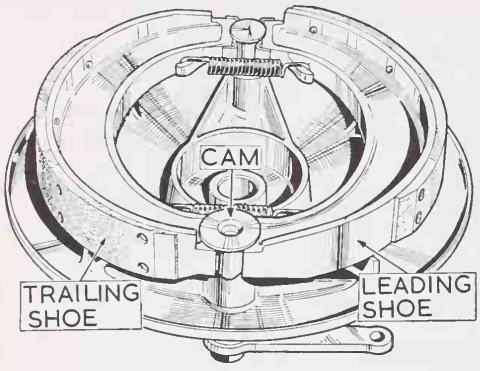
This comes when lining thickness is half-reduced. At this point the adjustment is pretty well taken up in most bikes. When half the adjustment has been used, it is a good idea to begin thinking about replacing the shoes, because the brakes lose quite a bit of effectiveness when hot. Most models have lining measuring approximately 1/16" thick when fresh.

Chain whining

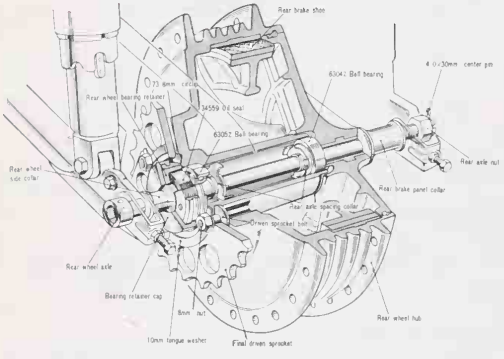
This stems from a too-tight condition. It should be a warning to the rider because excess tension causes chain and sprocket wear plus wear on



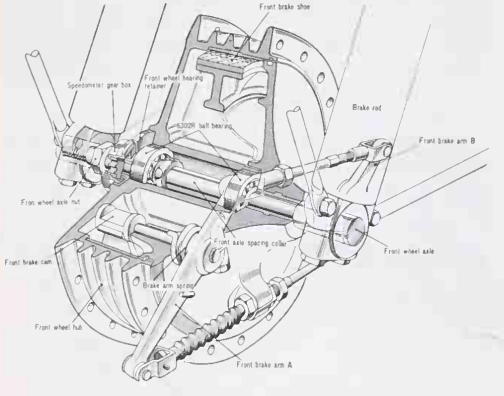
Removing front fork caps for wheel removal, BSA.



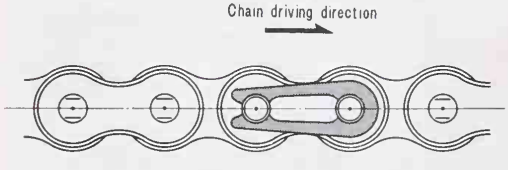
Shoe arrangement for front brakes, BSA.



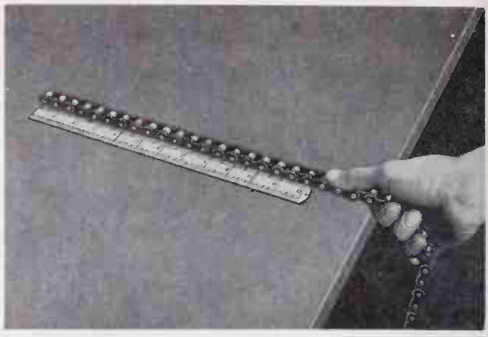
Cross section of rear hub, Honda 450.



Cross section of front hub, Honda 450.



Chain master link. Be sure closed end is in direction of rotation.



Stretching chain to determine amount of wear.

bushings and bearings in the transmission case, which leads to stripped gears and all sorts of good things.

Chain flopping

Rattling, slapping sounds signify excess slack. This is as bad as too tight a chain as far as sprocket wear is concerned and the intermittent shocks to the rest of the drive train don't do it any good either.

Chain adjustment

Proper chain adjustment usually calls for ½" to ¾" of slack halfway between sprockets with the machine on its wheels, unladen.

Chain tips

Oil the chain once a week, after every wash job, and after riding in the rain. Use a medium weight oil with Molykote or some similar molybdenum disulfide additive. A worn chain can wear the sprockets by rising up and down. A worn sprocket can ruin a chain. Replace the whole set when wear is evident. To determine if a chain is worn, remove it and hold it out parallel to the ground to check sideways deflection.

Wear of up to ¼ inch per foot is permissible inasmuch as this can be tolerated before the surface-hardening of the bearings is worn through. To check if the chain is serviceable, remove it, clean it thoroughly in solvent. Drive a nail in a flat surface, hook a link of the chain over it, and stretch it out as tight as possible. Here are the tolerances for various chains to be measured against a ruler.

⅝" pitch——16 pitches equals 10"; maximum: 10$\frac{7}{32}$".

½" pitch——23 pitches equals 11½"; maximum: 11¾".

⅜" pitch——24 pitches equals 9"; maximum: 9$\frac{3}{16}$".

When installing the chain, be sure the open end of the master link is away from the direction of rotation.

$4.95

CHILTON'S

MOTORCYCLE TROUBLESHOOTING GUIDE

by OCEE RITCH

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